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METHODS OF SECURING BETTER CO-OPERATION BETWEEN GOVERNMENT AND LABORATORY ZOOLOGISTS IN THE SOLUTION OF PROBLEMS OF GENERAL OR NATIONAL IMPORTANCE[1]

THE accumulated experience of nearly fifty years enables the Bureau of Fisheries to speak with some degree of assurance and definiteness on relations with working zoologists of the universities.

It is a pleasure and an honor to have this opportunity to refer to the nature and value of those relations; to indicate the importance of continuing and broadening them; and to commend to less fortunate government agencies the advantage of enlisting in their work the active aid of university zoologists.

While other government institutions may have had intimate and continuous relations with university zoologists, I believe there has been no other federal bureau in which the cultivation of such relations has been such a definite and sustained policy as in the Bureau of Fisheries; and I am confident that no other bureau has secured more noteworthy results in this way. To state that we have had every reason to be well satisfied with this association

[1] A symposium before the American Society of Zoologists, held at Baltimore on December 26, 1918, Professor C. E. McClung presiding, included papers and discussions as follows: Representing the Bureau of Entomology, Dr. L. O. Howard. Discussion by J. G. Needham. Representing the Bureau of Fisheries, Dr. Hugh M. Smith. Discussion by Dr. H. B. Ward. Representing the Bureau of Animal Industry, Dr. B. H. Ransom. Discussion by Dr. Herbert Osborn. Representing the Bureau of Biological Survey, Dr. E. W. Nelson. Discussion by Dr. R. K. Nabours. Relation of the Council of National Defense and the National Research Council to the Advancement of Research, Dr. John C. Merriam.

is to express in mild terms what must be obvious to every one familiar with the facts.

As one consults the early records of the bureau and recalls the later activities and developments, the conclusion is inevitable that our relations with the laboratory zoologists have been not only invaluable but actually indispensable to us. There is some ground for the belief that zoologists have obtained a measure of profit from the cooperation, but there can be no doubt that the balance of benefits is on the government's side.

The mutual relations that have existed from the beginning have consisted essentially of (1) personal service rendered to the bureau by university zoologists for particular investigations or special duties and (2) the extension of facilities to zoologists—professors, instructors, students—for conducting investigations in laboratories, on vessels, or in the field.

The advantages of this arrangement from our standpoint are: (1) That we have been able to obtain the personal aid of men preeminently qualified for studying special problems, often at the time when those problems have been most pressing; and (2) that we have been able to secure this cooperation at a cost to the government that must be considerd merely nominal, for no funds provided by Congress would have been adequate to command such services had it been necessary to compensate them at their full worth.

It was at the very outset of our career that we enlisted the services of the university zoologist Verrill for fundamental systematic work on the invertebrate animals of the northeast coast, which work, though now necessarily obsolete, has remained a standard. Verrill was followed by a veritable host of university men engaged for essential systematic work on the fauna of the fresh and salt waters of the country and its outlying possessions, and by a similar host who dealt with almost every other phase of aquatic zoology. I need not extol or discuss their work. I will merely recall to you, as some of those university zoologists whose labors in behalf of the bureau have been fruitful, Gilbert, Jordan and Snyder in systematic ichthyology; Bigelow, Forbes, Hargitt, Holmes, Linton, J. P. Moore, Osburn, Sidney Smith and Wheeler in systematic invertebrate zoology; Birge, Bumpus, Dean, Grave, Greene, C. J. Herrick, F. H. Herrick, Kellogg, Kofoid, Lefevre, Mast, Mead, Parker, Pearse, Peck, Reighard, Ryder, Tower and Ward in anatomy, physiology, embryology, ecology and life history. This list is not by any means complete.

As for the future relations of the bureau with universities—and this is the important matter before us—we ask for a continuation of the existing cooperative spirit and, further, we hope that, as far as practicable, the university zoologists may adapt some of their own researches to subjects of directly useful application and, whenever possible, let creatures of obvious economic importance receive more attention in the regular laboratory courses. The universities will not fail to appreciate the great need, especially in the immediate future, for affording every possible aid to the material as well as the intellectual welfare of the country. The noble response of the universities to the country's call to service in the great crisis through which we have been passing—when hundreds of members of the faculties placed at the disposal of the government their technical and professional skill and knowledge for practical use in every branch of public activity—has made a deep and lasting impress on the nation and has had a particularly happy influence for government bureaus engaged in scientific work, and, at the same time, should not fail to produce a sympathetic attitude among university men toward laboratories established and maintained at public expense for the conduct of scientific work with a practical object or application. There should result a more general recognition of the fact that government scientific bureaus whose function is public service should properly concern themselves chiefly with the applications of science to public welfare, and should devote their energies to pure science only in so far as may be necessary to launch successful enterprises in applied science.

Without having had an opportunity to confer with university men on this special subject, I venture to offer some views and suggestions regarding a proposed cooperative arrangement between the zoological laboratories of the universities and the scientific bureaus of the government.

The universities can perform an invaluable service to the government by keeping in touch with the progress and demands of the applications of science in operations of the bureaus.

The government can render a useful service to the universities by keeping them informed of zoological problems with which the bureaus are confronted and of subjects in which the researches of pure science would be of value.

The results of university research that are of significant value to the government should be promptly communicated to the respective bureaus.

To render the proposed cooperation effective, there should be some kind of organization in which the universities and the government are adequately represented, to the end that the needs of the government are fully made known and the possibility of the universities' filling those needs is fully canvassed.

There might be maintained a catalogue or register of zoological students and instructors in the universities, with their peculiar qualifications and their special subjects of study, and a statement of the conditions under which they might accept government employment, and a catalog of current and proposed governmental zoological investigations, with an account of their objects, scope, duration, needed personnel, etc.

The definite aims to be met would be to locate men for permanent or temporary service in government bureaus and to encourage the pursuit of promising investigations. It not infrequently happens that the government has need for men of peculiar qualifications and fitness for special zoological work, and the usual method of advertisement fails to reach or appeal to available men well fitted for that work. A central organization or committee could locate such men and bring to their attention the government's needs.

It sometimes occurs that in the course of investigations in the commercial or technical aspects of zoology, lack of scientific data may impede or prevent progress, so that work must be suspended until the required data are obtained. At the same time it may, and probably not infrequently does, happen that advanced zoological students are in position to take up investigations where the subject is not of so much consequence as the training in research. In such cases the government bureaus may supply problems that will afford excellent research training to the students, give promise of definite results for publication, inspire students with the feeling that they are contributing to the general welfare, and at the same time expedite work undertaken by the government.

One of the real hindrances to the proper development of the fishery service is the difficulty in securing assistants who, with such a knowledge of zoology as is imparted in a university course, are willing to enter the lower grades, work their way upward, and make this subject their life work or at least give it serious thought for a reasonable time. In aquatic biology, in aquiculture, in the various branches of technology as applied to water products, there is an inviting field in which there is ample opportunity for interesting and important original investigation.

A drawback hitherto has been the comparatively low compensation paid. There are, however, certain perquisites that must be taken into consideration, and there is reason to hope that Congress will soon make a readjustment of salaries. Pending the time when various schools of fishery may be established at the universities on a par with schools of forestry, the universities can render a distinct service to the Bureau of Fisheries (and to the fishery departments of the various state governments) by making an effort to direct the attention of students and graduates to the inducements and attractions afforded by the government fishery work, and perhaps to adapt parts of zoological courses and the research work of graduate students to practical problems associated with the country's aquatic re-

sources. It can not impair, but may enhance, the value of zoological study or scientific research to have it deal with subjects that may have a direct practical value in commerce, industry, legislation or administration.

In the readjustment of national and international relations growing out of the Great War, the aquatic resources of the world are certain to assume a more prominent place than ever before. It appears to me that for Americans one of the real compensations of the war is going to be an increased appreciation of and dependence on aquatic foods, many of them hitherto neglected or spurned because of our ignorance, prejudice or wasteful habits. This new attitude, evidence of which already exists, if properly encouraged and directed, can become an important factor in our national life. Among the questions that arise are: How can our matchless water resources best be adapted to the country's and the world's needs? How shall they be most adequately utilized and at the same time preserved from dissipation, or, in other words, what steps should be taken by the federal government, in cooperation with the state governments, to secure maximum production consistent with an unimpaired source of supply?

The Bureau of Fisheries will need all possible outside assistance in meeting increased duties and responsibilities that have already begun to devolve upon it; and there will be a greater necessity than ever before arose to invoke the cooperation of practical zoologists in the elucidation of problems connected with the administration of the fisheries and the conduct of fishery and aquicultural enterprises. Knowing as I do the limitations that are necessarily imposed on the make-up of our permanent scientific staff, it seems to me to be incontrovertible that our ability to measure up to the situation and meet the needs of the coming years will depend in large part on our success in enlisting for personal service and sympathetic counsel the trained minds in the university zoological laboratories or the trained students sent therefrom.

H. M. Smith

Bureau of Fisheries,
Washington, D. C.

The most cordial relations have always existed between the zoologists of the country and the Bureau of Fisheries. When the bureau was established, its work was placed in charge of one who was recognized as a scientific authority and who commanded the support of investigators in zoology because of his scientific standing. The same recognition is accorded to the present head of the Bureau of Fisheries and to his able corps of assistants.

The characteristic feature of these relations, however, has been the individuality of the situation. Recognition has been given the individual leader by the individual investigator and that cooperation in the activities of the bureau, which has been referred to so cordially by Dr. Smith, has resulted from individual initiative, for the teacher or investigator has responded to the personal requests of the scientific leaders in the bureau. Now, admirable as these relations have been in many ways, I do not look upon the cooperation as the most effective which can be secured, for it has not been animated and directed by the institutions of the country which concern themselves with the training of investigators and with the encouragement of research.

So far as I know there have been no fixed and formal relations in the past between the government bureau and the public or private colleges and universities. The results which have come from individual initiative are so conspicuously satisfactory, however, that one may confidently look forward to much greater benefits, if more extended and definite relations can be established between the Bureau of Fisheries and the educational research institutions of the country. The next question is naturally the direction, scope and character of such relations as are likely to yield greater results.

The paper of Dr. Smith has justly emphasized the need for greater work on the problems of aquatic resources and their utilization for human welfare. No comment is needed to demonstrate the social significance of the present high prices of food and of the heavy draft on the world's reserve of food stuffs in consequence of the war. To counteract the reduction in food supplies and the increased prices

of food articles no movement offers greater hope than that which draws into the realm of human consumption new foods and thereby lessens the demand on old supplies while at the same time it offers for the dietary of man a greater variety than was included before.

This is precisely the work of the U. S. Bureau of Fisheries. In various ways it contributes to the perpetuation and increase of the supply of well-known and long-utilized varieties of food fishes while at the same time it endeavors to find and utilize unknown or undervalued aquatic products. It has met with marked success in both lines of activity; but to make further progress, especially in the direction of discovering and utilizing new kinds of fish, and perhaps also of other aquatic organisms, research must come in to demonstrate the what and how in the situation. The universities of this nation are already many of them organized for research and others have made partial progress in the achievement of that organization so that they are able to do the research that is needed with less expenditure of money, time and energy than any other agency, especially in comparison with a new organization that must be built from the ground up. Furthermore, the universities have a multitude of young workers eager to find opportunities for a future career, and hence likely to be attentive to the appeals from this new field. To realize all the possibilities of this movement, therefore, there is need of more effective cooperation as well as more extended and more active effort.

There are two real educational problems, or two real points of attack on the one great problem, which are outlined in the presentation of Dr. Smith: (1) Technical training of young men for this work. This involves the introduction of courses of study which shall fit them to carry on the work demanded by the U. S. Bureau of Fisheries and by the corresponding state organizations. (2) Organization of science to permit the exchange of knowledge and formulation of plans, as well as to secure cooperation in solving the problems.

In spite of what has been said by others today I feel sure that the future of research is bound to be different from its work in the past. In the past the dominant note in scientific work has been a high degree of individualism; in the future I believe it will be a pronounced tendency towards correlation in the investigation of significant problems. When the U. S. government brought together chemists in Washington and set them to work on poison gases in warfare, this action broke down the ancient barrier supposed to exist between any control over individual activity and success in research. It assigned men a prescribed problem—and you all know how successfully this was met and solved. Individual action which has been so general in the past will, in my opinion, disappear gradually until men in scientific circles are working not under restraint, but under some general direction in a joint attack on these problems, the solution of which is of evident and most immediate value for the human race.

Training Younger Men for Expert Work of Bureaus.—To furnish scientific training for attacking and solving the problems of existence is a characteristic function of our universities. These institutions have sought, in recent years at least, to keep in touch with applied science, perhaps chiefly along individual lines; but no one of our universities is without some work in applied science, and the various schools of agriculture, engineering and laboratory science have reached a development truly characteristic of those institutions. It is natural that a similar training should be provided for aquiculture. To be sure, there are certain limits to this as the demand in the field is small as compared with that in agriculture and the number of men interested in pursuing such work is limited. Furthermore, the funds in the possession of institutions are limited and it is impossible to enter on the study of all problems. But even after all has been said and done, one must recognize a real demand upon the university to furnish help in this evident and increasing need.

Let me emphasize at this point the fact that in the course of their growth universities must come naturally to the same sort of spe-

cialization that individuals have reached. It has been characteristic of the larger institutions rather generally in this country during the past that whenever any department or line of work was suggested by one institution, every other one has desired at once to introduce a similar department. Now, funds are and in future will be even more lacking for duplication of new departments and our universities must face the problem of teaching subjects for which they are naturally adapted by their location and the funds at their command. It is very likely also that new topics which are taken up by any institution will have in many cases a genetic relation to the history and previous program of the institution as well as to its geographic location and natural advantages. Other limiting and directing influences will readily suggest themselves without further discussion of this point. But however the matter is determined, there is sure to be in future university development a clear recognition of the fact that it is neither possible nor desirable for each institution to cover all fields of developing knowledge. And this principle applies clearly to the special question under consideration.

Courses in aquiculture must be established to train technical workers and those institutions should embark upon the work which are advantageously located to undertake it, all factors being considered. It is also important to note that such work may follow either one of two distinct lines. There will be courses of a general character to train the routine worker, and those of advanced character to train the research worker. There is evident need in both directions in order to prepare men for general purposes and also to carry on research and direct the work of the former group. The general training will naturally be given in special undergraduate courses, whereas the special work must be provided in courses for graduate students.

I should like to emphasize here the necessity of having the specific cooperation of the Bureau of Fisheries in order to make this work successful in either phase. A certain amount of technical practise is inseparable from proper training in this field. It already exists under the control of the bureau, and the proper type of organization will bring these two things together so that the student getting training along theoretical and laboratory lines will be able to secure practical work under the Bureau of Fisheries. This practical training might well be given during the summer months. There are opportunities for this practise in connection with the operation of egg taking and other work of the fish hatchery and with the problems of fish foods to be worked out in the new laboratory of the bureau. There are opportunities of this sort at many points already controlled by the bureau, which might be very appropriately utilized for training men registered in these special courses. The bureau already provides in part for taking in college students, associating them with this work and giving them manual training in those processes essential for work in practical fisheries problems.

May I point out one feature known to the bureau which has proved thus far difficult to handle well and which is conspicuous to the outsider as a weakness in the present organization. The helpers drawn into this summer work are often only casually interested in the problem or concerned merely in getting a pleasant summer vacation. They are not men who are so directly interested in fish culture problems as to desire to make this summer training a part of their general education for service in fisheries work. If these summer positions could be filled first of all by men who are seeking to secure thorough training for work as fishery experts and hence directly interested in the problems of the fisheries, the students would be advantaged in their work and the training given would not be incidental but would form part of a general program that would ultimately serve to advance the work of the bureau and fisheries interests in general.

Organization of Science.—I touch upon this theme with some hesitation. The National Research Council has given intensive study to the problem, and the opinions of an outsider are likely to be premature or to appear of little value in comparison with Dr. Merriam's.

Some work has already been done to bring into closer touch the research worker and the bureau. Many of the men before me have enjoyed from time to time opportunities for carrying out investigations at various laboratories and have gained immensely, not only in their own work but in the possibilities for training younger men to meet the needs of the service. There is a demand for a more definitely organized program, one calculated to bring the university laboratory with its pure science and the bureau with its applied science into definite and intimate contact. Two lines of attack are possible:

First, the end desired might be reached under the direction of the research council or some branch of it through discussion or correspondence. The gain would be very great. I merely suggest one of the evident disadvantages in such a plan. It throws a heavy burden of labor on some central committee. Its success depends upon the existence of a machinery functioning actively enough to carry out all the processes of conveying the information and coordinating the plans. Furthermore, it suffers the disadvantage of being at times subject to the difficulties due to imperfect understanding. Men express themselves so differently that what is found on the written page is sometimes interpreted in a different way than was intended. This may be followed by a further waste of time spent in explanations. Extensive discussions in modern science have arisen from this very cause and the result is evident loss of energy.

The second method, which looks more likely to be successful, is a plan for having a divisional board of ten, fifteen or twenty members, which should be representative of different parts of the country, different institutions, different lines of work, and different regions that come in contact with different phases of existence—a board to have meetings as a general body and able to have personal conferences with representatives of the Bureau of Fisheries. The advantages of personal contact seem to make this a more profitable line of attack than the other, though I am not blind to the difficulties in both suggestions. Personal discussion brings up new points of view and yields keener analyses of any situation; it provides, I believe, means for meeting difficulties more readily than methods of conference by letter.

I want to indicate clearly, however, that if such a plan is to be tried this board must be directly subject to the Bureau of Fisheries. I am confident that the history of the past shows that no undesirable connotation can be attached to the words "subject to." The bureau has responsibility for these problems given it by the people and should have the final authority in such an arrangement. It should have freedom to suggest where in its experience certain plans do not seem to be feasible.

It would be possible for such a body to hold sectional or topical conferences for the discussion of problems important in a particular region or for the solution by joint action of a question of serious import at a particular time. The membership of such conferences could be specifically determined with reference to the special need and the definite questions that demanded experimental investigation or laboratory study to be taken back to the universities for research and report at some later date. Other advantages will evidently accrue from this association of technical experts and scientific investigators in a board which could outline a plan of active and direct procedure with a view to securing the necessary knowledge whether it was already in existence or had to be worked out by investigators properly equipped with library and laboratory facilities.

Such a board would exert a powerful influence outside of that which it might have in developing a program; it would possess power to push those lines of activity which are seen on analysis to be not only right but essential. Important items often appeal to men in legislative halls or to the general public as being quite unnecessary or even foolish. A board representing the public at large would give a weight to its views that could not be imparted to them in any other way.

Of course, one has to consider also another aspect of the question. It is inevitable that

attempts be made from time to time to force the introduction of unwise policies and the modification of well-planned organization; these influences may emanate from political centers and sources that are unfortunate. At best such influences delay the progress of scientific investigation and the application of scientific methods, in this instance to the Bureau of Fisheries; at worst they destroy work built up by laborious efforts in the past. We must be awake to the need not only for building an organization and for securing the best so that it can weather the shifting of political results but also for directing the organization parties and of public opinion in politics.

HENRY B. WARD

MEDICINE, A DETERMINING FACTOR IN WAR[1]

THE death rate in our Civil War of killed and dying of wounds is given as thirty-three per thousand, the disease death rate as sixty-five. In the Spanish War the death rate from battle is five and the death rate from disease 30.4 per thousand. In the present war, taking the statistics up to March 28, 1919, we find the rate of death from wounds received in action is 14.191 and that of death from disease is 14.797 per thousand. This includes the army on both sides of the ocean. The statistics of the American Expeditionary Forces, with an average strength of 975,716, reveal a rate of death from wounds in action of 31.256 per thousand and a death rate from disease of 11.233. Of those who died of disease, pneumonia claimed 9.146 per thousand.

Studying comparatively the diseases of the American armies during the Civil War, Spanish-American War and the recent war, we find that malaria was one of the chief causes of disability in both the Civil War and the Spanish-American War, though it caused but 6 per cent. of the deaths in the Civil War and but 10 per cent. in the Spanish-American War. But in the recent war malaria has caused such a small number of deaths that it is not given in detail, but is put into the aggregate term of "other diseases." Typhoid fever, with typhomalaria, so called, was one of the chief causes of death from disease in both the Civil War and the Spanish-American War, causing 22.4 per cent. of the deaths of the Civil War, and being the one great uncontrolled epidemic of the Spanish-American War, causing in the fighting period of the latter war 60.5 per cent. of all deaths. But in the recent war only 0.4 per cent. of the deaths are chargeable to this scourge. Pneumonia, on the other hand, causing only 13 per cent. of the deaths during the four years of the Civil War and only 3 per cent. in five months of the Spanish-American War, has become the dreaded epidemic of the recent war, causing in the American army 85 per cent. of all deaths from disease. In the Civil War, meningitis caused 2 per cent. of the deaths, and 2 per cent. of the deaths in the Spanish-American War, and it caused 4 per cent. of the deaths in this war. Smallpox caused 4 per cent. of the deaths in the Civil War; in the Spanish-American War, one man died of this disease; in this war, one man died from smallpox in the United States and five in France. In 1918 and in the first months of 1919, there were 102 patients with smallpox admitted to the hospitals in the United States. These patients came into the various camps from civil life, for the disease developed among the recruits before they could be vaccinated and thus protected, but it has not developed at all among the vaccinated troops in the United States. Dysentery caused 28 per cent. of the deaths in the Civil War, and nearly 30 per cent. (29.3 per cent.) of the 5,600,000 cases of disease reported in that war. In the Spanish-American War it caused 5.6 per cent. of the deaths. But it caused only forty-one deaths out of 48,000 cases, or 0.08 per cent. of the deaths in the recent war. The transmission of yellow fever by mosquitoes does not come into consideration in the recent war, though there were small epidemics of this disease in both the former wars, there being about 1,300 cases in the Civil War and about 1,100 in the Spanish-American War.

There is one achievement by the Medical

[1] From the presidential address of Dr. Alexander Lambert given at the Atlantic City Meeting of the American Medical Association and printed in the *Journal* of the association.

Department of the United States Army after the Civil War which stands as a lasting monument to the industry and genius of the surgeons of that time; it is the "Medical and Surgical History of the War of the Rebellion." This was the first great medical history ever published of any war, and remains still the standard to be attained.

As a result of the scientific medical work during and after the Spanish-American War, the investigations of three American army surgeons, Jesse Lazear, James Carroll and Walter Reed, gave to the world the solution of the problem of the transmission of yellow fever by mosquitoes. With this knowledge, came simultaneously the power to control this dread disease, which for centuries had been the scourge of the West Indies, and had time and again spread in devastating epidemics to this country and even to southern Europe. Lazear and Carroll laid down their lives to gain this knowledge, and paid the ultimate sacrifice in order that thousands, through their work, might be protected and live. The sanitary control of mosquitoes, and thus of tropical malaria and yellow fever, and the wise administration of this knowledge, made possible the building of the Panama Canal. It was an American army surgeon, William C. Gorgas, who seized this great opportunity and transformed a pesthole of tropical diseases into a healthy and safe terrain, that the engineering genius of the United States Army might be free to construct the canal. The French under De Lesseps had failed because of the epidemic and tropical diseases which were at that time uncontrollable. Disease had defied and overcome engineering skill and genius. Preventive medicine controlled and conquered.

Ten years ago the practical application of the knowledge gained from the study of the epidemic of typhoid fever of the Spanish-American War brought about the compulsory inoculation against typhoid in the United States Army. It had been shown by the Vaughan and Shakespeare Board that nearly 65 per cent. of the typhoid fever of that war was transmitted by contact of man with man, and was not water borne. Hence sanitation could only reduce typhoid to a certain level and not eradicate it. The introduction of compulsory typhoid inoculation in the army has practically eradicated the disease. Following the work of the English medical corps in the Boer War, a United States Army surgeon, F. F. Russell, made possible the practical application of this method in the U. S. Army and proved conclusively that typhoid fever could be completely controlled. The American Army Medical Corps has, in the recent war, discovered the transmissibility of trench fever by body lice, and thus has shown the means of prevention of this new disease which, while killing no one, rendered thousands of men useless for weeks and ineffective for fighting. This discovery came to save thousands of men for the fighting lines at a time when they were urgently needed.

Medical science has to-day, therefore, within its grasp the power to control the diseases which, in former times, decimated warring armies and spread out from these armies among the non-combatant populations. Formerly, when war broke out, it was almost inevitably followed by some dread pestilence among the civil populations of the countries in which the war was waged. By proper sanitation and preventive inoculation, dysentery and cholera can be abolished; by vaccination armies can be protected against smallpox. Body lice disseminate typhus, recurrent fever, and trench fever, and by proper disinfection of these vermin these diseases cease to occur. Through sanitation and preventive inoculation, typhoid fever, the scourge of the two previous wars, is absolutely controlled, and this includes also paratyphoid, which has been recognized as a separate entity only since the Spanish-American War. In the Spanish-American War, 60.5 per cent. of all deaths were caused by typhoid, and in the present war 85 per cent. were caused by pneumonia. The typhoid of the Spanish-American War was due to local causes and local epidemics. The pneumonia of this war was beyond control, and was part of a world-wide epidemic that swept over both hemispheres, and the morbidity and mortality of some of the cities

of this country exceeded those of the camps. Subtracting the death rate caused by pneumonia from the total death rate by disease in the recent war we have 2.2 per thousand for the entire army on both sides of the water, which is practically a peace-time death rate. Meningitis has caused, in this war, ten times as many deaths as typhoid fever; pneumonia has caused two hundred times as many. Mumps and scarlet fever, of the infectious diseases of the young men, remain as yet to be controlled, but they are not of great import in the armies in war. The disabling type of disease coming under the head of venereal disease has, in this war, been so controlled that the number of cases brought from civil life was greater than the number occurring in the American Expeditionary Forces in France, which was reduced to twenty-two per thousand per year, a rate only one eighth as high as the incidence among recruits coming from civil life, and only one third as high as the best that ever had been accomplished in the army before.

Influenza, measles and pneumonia, in the respiratory group, still stand as baffling problems, and their control has not been accomplished. Measles appeared and spread until it no longer had material on which to spread, as one attack confers immunity to a second. Pneumonia, following influenza or originating as a primary disease, still eludes control. But the knowledge which we have gained in this war of the methods of its spread, of the various infectious organisms which produce it, and their various types and varying virulence, of its occurrence as a secondary complication to measles and influenza, has enormously increased. The value of the facts thus learned are incalculable, and belief is justified that the problem is better understood than ever before, and that we soon shall see the solution of these problems.

The occurrence in the camps of meningitis, another disease of the respiratory group, as far as its portal of infection is concerned, has been forty-five times as frequent in the army as its occurrence in civil life among the same age group. This has been due to overcrowding and the diminution of air space allowed the individual soldier in badly ventilated barracks. The responsibility for these sanitary sins rests on the General Staff and not on the Medical Corps.

What then are the lessons that we can draw for future action? There is no question but that the salvage of human beings, the protection of troops from disease in an army, renews and saves the fighting forces. Until recently, until medical science could control disease during war time, armies had been more decimated and injured by disease than through battle casualties. Now that, except for epidemic spread of respiratory diseases, the communicable and epidemic spreading diseases can practically be controlled, the medical corps of an army has become an essential part of the fighting organization. Whole nations must now go to war. No longer can they mobilize a selected portion of volunteers and send them to fight the war and defend the nation. Since all the youth of the nation must mobilize and turn to war, it becomes the duty of a general staff to save its man power and to salvage it to the greatest extent possible. The history of the Crimean War, of our Spanish-American War, and our experience in the recent war have clearly shown that only through proper representation on the general staff by those men trained in such salvage, and by experts in such knowledge of sanitation, can this duty be performed. When the General Staff of the United States Army comes to realize this fully, one can not conceive that it will fail to give proper representation in its councils and organization to the Medical Department. The practical necessity for this was finally recognized in the A. E. F. by General Pershing and three medical officers were detailed at General Headquarters as substantive members of the General Staff. Responsibility and authority can not be separated, and only by such organization can adequate authority equal the inevitable responsibilities.

In the mobilization of the industrial forces of the nation by the Council of National Defense, the health of the nation and the protection of both nation and its armies was regarded of such importance that it demanded

direct representation of the medical profession on this board. This is also true of the navy, for its Medical Department is represented on the General Board. Oddly enough, the anachronism still exists that in the General Staff of the United States Army the Medical Department is regarded as an outsider. The safeguarding of the health and fighting vigor of an army, the salvage of its wounded, the saving of man power through protection from disease are still regarded as foreign to staff organization. The medical and sanitary formations are still regarded as non-combatants, although those serving with the troops often go forward and mingle with them in the combats, that the morale of the men may be better sustained. Duty demands it, and they have shown themselves willing, in this war, to be unarmed combatants, not non-combatants. The ratio of the medical officers killed and dying of wounds has been exceeded only by that of the infantry and artillery, which branches necessarily bear the brunt of the battles. The pro rata death rate of the medical officers has exceeded that of aviators and of engineers.

This subject is a matter for congressional action, but the profession of this country, while the experiences of this war are still vivid in its mind, must turn to the Congress, must make an intelligent exposition of these facts, and must bring about, by legal enactment, an adequate representation of the Medical Department on the General Staff of the army.

I desire to draw but one more deduction from the medical lessons of this great war, and that in reality is the climax toward which everything points. That is, if this nation, through its present medical knowledge, has within its grasp the power to control communicable, and hence preventable, diseases, there must be established a nation-wide controlling organization for this purpose a National Department of Health. Over 33 per cent. of our younger men were disqualified from the draft for physical defects. There is need of wider supervision of our growing boys and girls to build up a more robust nation, and it is especially urgent in rural districts. If we are to have some form of universal military service, the very necessity of its universality demands some general supervision of the health of the youth of the nation, through protection against the transmissible diseases, and direction over the giving of health to the people as we now give education. This war has taught that there remains economic value in the maimed and wounded, and it is our duty to develop this value to its fullest extent. The maiming and injury of our workers, in the every-day work of industry, far exceeds each year the battle casualties of this war, and there is an economic necessity and duty to be performed in the salvage and reconstruction of the industrially injured.

Malaria still prevents the use of large areas of our southern states, and saps the energy of a large portion of the population. Typhoid fever still rests as a blot on the rural hygiene of this country. The control of epidemics between states is already in the hands of the Public Health Service, and within states, if state authorities request aid. Quarantine from outside infection is also under federal control. There are many other federal activities partially supervising health and disease through the various departments of the federal government. But it all lacks the efficient power of central correlation, and there remain many public health activities that should be undertaken by central action, from some of the problems of infant mortality to the problems of the increase of degenerative diseases of late middle life. It is the duty of the American Medical Association, and of each member of each state association, to urge on Congress the establishment of a National Department of Health.

WALTER GOULD DAVIS

THE meteorological service of the Argentine Republic will be the enduring monument of Walter Gould Davis, whose death on April 30, at his old homestead in Danville, Vt., removed one of the world's best-known and most highly respected meteorologists.

As a young man Mr. Davis went to Argentina to serve as assistant to Dr. Benjamin

Apthorp Gould, who founded the Astronomical Observatory at Cordoba, and, in 1872, established the Argentine Meteorological Service, which was installed in the Astronomical Observatory, the two organizations being independent of one another, although under the same director. Dr. Gould continued in charge of this service until towards the end of 1884, when he left Argentina, and in 1885, Mr. Davis succeeded him as director, continuing in that position until his retirement in May, 1915, after thirty years of active work. Under Mr. Davis's able leadership, the Argentine Meteorological Service attained a position in the very front rank of government meteorological organizations. When he resigned his post, to secure well-deserved rest and to seek to regain his health in his own country, the Argentine service extended over an area of nearly 3,000 miles in a north- and south-line, its southernmost station being in the South Orkney Islands, in latitude 60° 43′ south. Over 2,000 stations were then cooperating in the work of taking meteorological and magnetic observations. The morning and evening observations from nearly 200 stations were being used in the construction of the daily weather map, in addition to the daily rainfall records from about 1,350 rainfall stations.

The development of meteorological work under Mr. Davis was rapid and many-sided. In 1885, the year in which he became director, the Meteorological Office (Oficina Meteorologica Argentina) was made a separate organization, and its headquarters were moved from the Astronomical Observatory to a larger and better building, especially built for the purpose, the grounds immediately adjoining. In 1901 the central office was moved to Buenos Aires, where the telegraphic and other facilities for the preparation of a daily weather map, publication of which was begun on February 21,1902, were much greater than at Cordoba. A hydrometric section was established in 1902; a magnetic section and a forecasting service in 1904; a rainfall service in 1912, and a system of weekly, or longer forecasts in 1915. The section of climatic statistics has continued to have its headquarters at Cordoba, where it collects and compiles climatological data, maintains a first-class observatory, and is carrying on researches in agricultural meteorology.

Mr. Davis was a tremendously keen, active and progressive director. He was not only an unusually efficient executive officer, but he was also a man of wide learning and of a great variety of interests. Both as director, and as a man, he had the respect and loyal devotion of all his associates and employees. He was always well abreast of the times, and often was a pioneer in keeping ahead of the times. Not content with covering the mainland of his great district with meteorological stations, he extended his service into the Antarctic province to the south. An illustration of his desire to have the organization under his control contribute in every possible way to the advancement of meteorological knowledge was his acquirement, in 1904, of the meteorological and magnetic station at Laurie Island, in the South Orkneys, which had originally been established by the Scottish Antarctic Expedition. Since 1904, this remote southern station has been operated, without a break in its records, as a part of the Argentine Meteorological Service. The personnel of this lonely outpost is relieved only once each year, when supplies are sent for the coming twelve months. The men are then completely isolated, without (at last accounts) any mail or cable communication, until the relief vessel returns the following year. Under these conditions of extreme loneliness and hardship, the observers at Laurie Island have maintained their observations for fifteen years. This is a remarkable record of scientific work of the greatest importance in the study of world meteorology. In his Laurie Island station Mr. Davis always took great pride, and well he might do so.

Fully alive to all the needs of his service, Mr. Davis called to help him in his scientific work the best meteorologists whom he could find. From this country, he secured Professor F. H. Bigelow, formerly of the Weather Bureau, who has had charge of the magnetic work in Argentina since September, 1915; Mr. H. H. Clayton, formerly of Blue Hill Observatory, and since 1913 chief of the De-

partment of Forecasts in Buenos Aires; Mr. L. G. Schultz, chief of the magnetic section until 1915 and others. Mr. George O. Wiggin, the present director of the Argentine Meteorological Office, is also a native of the United States.

The high quality of Mr. Davis's work was fully appreciated by his meteorological colleagues everywhere. His reputation as a meteorologist and as the successful administrative head of a large and remarkably efficient organization won for him a position on the International Meteorological Committee, the highest international authority on meteorology. This was a well-deserved recognition of the importance of his contributions to meteorology, and of his sound judgment on scientific matters.

The many publications of the Argentine Meteorological Service which were issued under Mr. Davis's direction constitute an inspiring record of splendid work, well planned, thoroughly organized, and ably carried out. For comparatively few countries are there available such excellent meteorological and climatological publications, some of them in English, as the Argentine Meteorological Service has sent out.

By the death of Walter Gould Davis the world has lost one of its most eminent meteorologists, and those of his colleagues who had the privilege of knowing him have lost a warm-hearted, sympathetic and helpful friend.

ROBERT DEC. WARD

HARVARD UNIVERSITY,
May 31, 1919

SCIENTIFIC EVENTS

THE VOLCANIC ERUPTION IN JAVA

OFFICIAL advices received by the State Department report that the recent eruption of the Klot (or Kalut) volcano in Java cost 40,000 native lives, destroyed 20,000 acres of crops, principally rice, by its flow of hot mud, and did millions of dollars' damage by the falling ashes in regions outside the devastated districts. The National Geographic Society has issued from its Washington headquarters the following bulletin:

Volcano-made in the first place, and constantly being remade by them, Java has more volcanoes than any area of its size in the world. Estimates of the active and extinct craters range from 100 to 150. Everywhere in Java, in the huge crater lakes, in fissures that now are river beds, even in ancient temples, half-finished when interrupted by some fiery convulsion, are evidences of cataclysmic forces—such turbulent forces as now are in continuous hysteria in the Valley of the Ten Thousand Smokes in Alaska and break their crusted surface cage intermittently in Java.

The "treacherous Klot," as the natives call it, all but wiped out the town of Britar, but even its devastation, as reported to the State Department, was mild compared to the violent upheaval of Krakatoa in 1883. Then mother nature turned anarchist and planted a Gargantuan infernal machine on the doorstep of Java. Krakatoa is a little island in the Sunda Strait, between Sumatra and Java. Australians, as far from the explosions as New York is from El Paso, heard the terrific detonation, more than half the island was blotted out, parts of it were flung aloft four times as high as the world's highest mountain, and to touch bottom below the water's surface, where most of the island has been, henceforth required a plumb line twice as long as the height of the Washington Monument. Skyscraper waves flooded adjacent islands and rolled half way around the earth. Every human ear drum heard, though it may not have registered, the air waves as they vibrated three or four times around the earth.

Krakatoa levied a smaller toll in human life than Klot because of its isolation, and many of the 35,000 deaths from Krakatoa's eruption were at far distant points by drowning.

An eruption anywhere on the island means disaster. For Java, about equal in area to New York state, supports a population greater than the combined populations of the empire state and the four other most populous states in the Union—Pennsylvania, Illinois, Ohio and Texas.

EXPEDITION FROM THE CALIFORNIA MUSEUM OF VERTEBRATE ZOOLOGY TO ALASKA

THE museum of vertebrate zoology of the University of California has again undertaken field work in Alaska, and a party to work in that region left the Museum on May 14, to be gone until October 1. The route for the present season is to lie in southeastern Alaska in the vicinity of Wrangell. It will

follow up the Stikine River from the sea eastwardly into the interior to the vicinity of Telegraph Creek, British Columbia. The purpose of the work will be to gather specimens and all sorts of natural history information concerning the mammals and birds of the section traversed, particularly in order to learn how the fauna of the relatively arid interior differs from that of the humid coast belt, as also what happens where the two faunas meet.

Several seasons of work in the same general region have brought together large collections from adjacent sections and these have already been reported upon fully in a series of papers published from the University of California Press; so that the new material will be gathered and interpreted upon a more advantageous basis than would otherwise be possible.

The present year's field work is in charge of Mr. H. S. Swarth, curator of birds in the museum, and he will be assisted by Mr. Joseph Dixon, economic mammalogist, as also by a local trapper and hunter.

This opportunity of the museum of vertebrate zoology to resume its field work in southeastern Alaska is due to the special interest of Miss Annie M. Alexander, who is providing the means whereby the work can be carried on there. This is in accordance with the general plan adopted by Miss Alexander some years ago, namely, to contribute to a more complete knowledge of the vertebrate fauna of the Pacific coast of North America.

As heretofore, all of the field notes, photographs and specimens, which latter include study skins, skeletons and skulls of mammals and birds, become at once the property of the University of California.

INTERNATIONAL ENGINEERING STANDARDIZATION

The Electrical World states that Professor Comfort A. Adams, of Harvard University, president of the American Institute of Electrical Engineers, has returned from the trip which he made to England and France with H. M. Hobart, of the General Electric Company in the interest of standardization. Mr. Hobart remained abroad and is doing work of the same character as that in which he and Professor Adams were engaged. Mr. Hobart will probably return about the middle of July.

Professor Adams and Mr. Hobart crossed the Atlantic to adjust certain differences between the American and French rules with regard to the rating of electrical machinery which had arisen during the war, when a meeting of the International Electrotechnical Commission was not possible. As a result of the conferences held abroad an arrangement was made satisfactory to all concerned, and certain changes from the previous International Electrochemical Commission rules will therefore be recommended at the next regular meeting of that commission. This meeting will probably be held in London during the latter part of October in this year.

Another commission of Professor Adams and Mr. Hobart was on behalf of the American Engineering Standards Committee in order to establish relations with corresponding committees in other countries. In France the corresponding organization is called a Permanent Commission on Standardization and is appointed by the Minister of Commerce. In Holland the organization is known as the Normalization Bureau. In England it is the Engineering Standards Association and was organized originally by the five national engineering societies. It has government affiliations and regularly does the standardization work of the government in certain important fields. In Switzerland a similar organization is contemplated, but it has not yet been perfected. The organizations of Holland and France are of comparatively recent origin, as is the American Engineering Standards Committee. The British association has been in operation about eighteen years and is doing an enormous amount of very important work, having secured the confidence of the government and many organizations (including those in the railway and shipbuilding fields) not directly represented on the main committee. For example, the aircraft section alone of the Engineering Standards Association has about fifty subcommittees.

As a result of the conference held by the

American delegates with the representatives of the organizations of other countries, very cordial relations were established with those associations. The resulting cooperation should prove of immense value to international commerce, as well as effect a reduction in cost of production in many fields.

RESOLUTIONS OF THE AMERICAN FEDERATION OF LABOR ON SCIENTIFIC RESEARCH

WHEREAS, scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining, and others must rest; and

WHEREAS, the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

WHEREAS, the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase since there is a limit beyond which the average standard of living of the whole population can not progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry; and

WHEREAS, there are numerous important and pressing problems of administration and regulation now faced by federal, state and local governments, the wise solution of which depends upon scientific and technical research; and

WHEREAS, the war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare; whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertakings are already active; therefore be it

Resolved, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the federal government, and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the Secretary of the Federation is instructed to transmit copies of this resolution to the President of the United States, to the president pro tempore of the Senate, and to the speaker of the House of Representatives.

NATIONAL RESEARCH FELLOWSHIPS

THE National Research Council announces further appointments to national research fellowships in physics and chemistry. Previously six appointments were announced—three in chemistry and three in physics. The object of the National Research Council in maintaining a system of research fellowships is to promote fundamental research in physics and chemistry primarily in educational institutions in the United States. Fellowships are awarded to persons who have demonstrated a high order of ability in research for the purpose of enabling them to conduct investigations at educational institutions which make adequate provisions for research in physics and chemistry. The new appointments are as follows:

In Chemistry

Warren C. Vosburgh, of New York City. B.S. Union, '14; A.M., '16; Ph.D., Columbia, '19. Research assistant to the professor of chemistry at Columbia University for the past six months.

George Scatchard, of New York City. A.B. Amherst '13; Ph.D., Columbia, '17. Formerly research assistant to the professor of chemistry at Columbia University and instructor

in organic chemistry; first lieutenant, Sanitary Corps, U. S. A.

In Physics

Ernest F. Barker, of London, Canada. B.S. Rochester, '08; M.A., Michigan, '13; Ph.D., 15. Professor of physics Western University, London, Canada, since 1915.

Albert Edward Caswell, of Eugene, Oregon. A.B. Stanford, '08; Ph.D., '11. Professor of physics, University of Oregon, since 1917.

The members and acting members of the research fellowship board are as follows: Wilder D. Bancroft, Henry A. Bumstead, Simon Flexner, George E. Hale, Elmer P. Kohler, A. C. Leuschner, Robert A. Millikan. Arthur A. Noyes, E. W. Washburn.

SCIENTIFIC NOTES AND NEWS

Dr. George Ellery Hale, director of the Mount Wilson Observatory and foreign secretary of the National Academy of Sciences, who has been for the last ten years a correspondent of the Paris Academy of Sciences, has been elected a foreign associate, taking the place of Adolph von Baeyer, declared vacant by the academy. The foreign associates are limited to twelve, and the distinction has been held by only two Americans—Simon Newcomb and Alexander Agassiz. The National Research Council, upon the presentation and acceptance of Dr. Hale's resignation as its chairman and the election of Dr. James R. Angell as his successor, "created and bestowed in perpetuity upon Dr. Hale the title of honorary chairman in recognition of his services to the National Research Council and to science and research by indefatigable efforts that have contributed so largely to the organization of science for the assistance of the government during the war, and the augmentation of the resources of the United States through the newly intensive cultivation of research in the reconstruction and peace periods that follow."

A distinguished service medal has been awarded to Colonel William H. Walker, Chemical Warfare Service, U. S. A., for exceptionally meritorious and conspicuous service. "His extraordinary technical ability, untiring industry and great zeal have enabled remarkable results to be achieved in the production division of the Chemical Warfare Service in the face of many obstacles encountered." Colonel Walker has been discharged from the Army and has returned to his home in Bridgton, Maine.

The University of California has conferred its doctorate of laws on President Ray Lyman Wilbur and Professor Vernon Charles Kellogg, of Stanford University.

The degree of doctor of science has been conferred by Dartmouth College on Dr. Raymond Pearl, of the Johns Hopkins University.

For scientific exhibits at the Atlantic City meeting of the American Medical Association the gold medal was awarded to Dr. H. S. Warthin and the silver medal to Dr. Hideyo Noguchi.

Dr. R. F. Ruttan, of McGill University, Montreal, president of the Royal Society of Canada, has been deputed to represent Canada at the International Research Council which meets in Brussels on July 18. He will also attend the Inter-allied Federation of Chemists to be held in London as the representative of the chemists of Canada.

Dr B. E. Fernow, dean of the faculty of forestry, University of Toronto, Toronto, Canada, since its inauguration in 1907, retired at the close of the session just concluded. He has been appointed professor emeritus. Dr. C. D. Howe, a member of the faculty has been appointed acting dean.

Professor I. Bayley Balfour has been awarded the Linnean gold medal of the Linnean Society, London.

At the seventy-first general meeting of the Institution of Mining Engineers held in London on June 19, medals were presented to Dr. Auguste Rateau, of France and M. Victor Watteyne, of Belgium.

Dr. John Dewey has been invited by the Chinese government to assist in the reorganization of its educational system and has for this purpose received a second year's leave of absence from Columbia University.

LEAVE of absence has been given by the University of California to W. C. Bray, professor of chemistry, who will become one of the three directors of research in the new nitrate division laboratory of the government.

CAPTAIN W. E. CARROLL, who has been in the Sanitary Corps of the Army in France, has been honorably discharged and will resume his duties as head of the department of animal husbandry at the Utah Agricultural College and Experiment Station.

PROFESSOR L. M. WINSOR, who has been in South America as consulting engineer on an irrigation project, has returned to Utah where he will resume his irrigation investigations with the Utah Agricultural Experiment Station and the U. S. Department of Agriculture cooperating.

B. R. MACKAY will be in charge of a party sent out by the U. S. Geological Survey to make explorations in British Columbia.

DR. E. W. GUDGER, of the North Carolina College for Women, Greensboro, N. C., is spending a year's leave of absence at the American Museum of Natural History of New York City, where he is associated with Professor Bashford Dean in editing the third and index volume of the Bibliography of Fishes. Letters and separates may be addressed to him at the museum.

DR. MAURICE L. DOLT, professor of organic chemistry at the North Dakota Agricultural College, has resigned to accept a position as research chemist with the American Cotton Oil Company.

THE Committee on Scientific Research of the *Journal* of the American Medical Association has made an appropriation for the preparation of a critical summary of the epidemiology and bacteriology of the influenza pandemic. The work has been placed in charge of Professor Edwin O. Jordan, of the University of Chicago. It is requested that reprints of articles and statistical records on influenza be forwarded to Professor Jordan as soon as published.

DR. M. CURTIS FARABEE, who was ethnographer to the American Commission to Negotiate Peace and went to Paris with President Wilson's party, has returned to the University of Pennsylvania. While in Paris he was made a corresponding member of the Paris Anthropological Society and of the Association for the Teaching of Anthropological Sciences.

DR. REGINALD A. DALY, professor of geology at Harvard University, will go to Samoa this summer under the auspices of the Carnegie Institution of Washington to study the volcanic formations and coral reefs of the Samoan Islands.

MAJOR VICTOR CLARENCE VAUGHAN, JR., on duty with the American Expeditionary Forces was accidentally drowned in France, on June 10. Major Vaughan, who was born in Ann Arbor, in 1879, was associate professor of preventive medicine and assistant professor of medicine in the Detroit College of Medicine and Surgery, and the author of valuable contributions to pathology and bacteriology.

ADDITIONAL information regarding the observations made by Dr. Bauer's party at Cape Palmas, Liberia, during the total solar eclipse of May 28–29, states that the magnetic effect observed in previous eclipses has been confirmed. The inner corona was very bright, and marked outer corona extensions south southeast and north northwest were observed. No shadow bands were seen.

THE Selous collection of big-game trophies has been presented to the Natural History Museum, London, by Mrs. Selous, is said by *Nature* to be the finest ever brought together as the product of one man's gun. It consists of some five hundred specimens shot by the late Captain F. C. Selous, D.S.O., during a period of nearly forty years, some of the trophies dating from his earliest days as a hunter. The greater part of the collection is African, but there are many specimens from Canada, Newfoundland, the southern Carpathians and Asia Minor. Mrs. Selous has also presented to the Natural History Museum the superb collection of European birds' eggs, every clutch in which was collected by Captain Selous, and is labelled most carefully, with exact date and locality. The specimens will in due course be

removed from Worplesdon to South Kensington, and kept together as the "Selous collection" for a period of years.

The establishment of a new Jardin des Plantes is proposed for France in the park of Versailles between the Trianon (villas of Louis XIV. and XV) and the Forest of Marly. The new garden of about fifteen hundred acres will be, to a large extent, supplemental to the old Jardin des Plantes in Paris, the further expansions of which has been shut off by the growth of the city.

A conference devoted to the consideration of problems of reconstruction in relation to public health was held in London from June 25, to June 28. The subjects considered were under the following heads: (1) The Work of the Ministry of Health; (2) The Prevention and Arrest of Venereal Disease; (3) Housing in Relation to National Health; (4) Maternity and Child Welfare, and (5) The Tuberculosis Problem under After-War Conditions.

Miss Elizabeth C. White is offering $50 apiece for wild blueberry bushes bearing berries as large as a cent. She has already secured two such plants from New Jersey. Besides propagating from these bushes for her own blueberry plantation she will furnish cuttings of them to Mr. Frederick V. Coville, of the United States Department of Agriculture, for use in his blueberry breeding experiments. Details of the offer can be had from Miss White, whose postoffice address is New Lisbon, New Jersey..

The University of California, in cooperation with the U. S. Bureau of Soils, has started work on the soil survey of the Big and Little Shasta Valleys in Siskiyou County. E. B. Watson, of the Bureau of Soils, is in charge of the work and is assisted by Professor Alfred Smith, of the university. The survey will cover about 450 square miles and when completed will be published with a map showing the location of each of the soils that occur in the region and a report in which each of these soils will be fully described. The report will also contain a discussion of the agricultural conditions of the region and of the crops that can be grown on the soils.

The British government proposes to expend during the next five years about £2,000,000 on agricultural research and agricultural education. Substantial scholarships will be offered to men who have distinguished themselves in the natural sciences at the universities, and a certain number will be selected for employment in universities and other institutions. *Nature* says that research is already carried on at Cambridge, Rothamsted, Bristol and Reading; but whereas at present there are probably not more than forty men in England and Wales engaged on pure research in agricultural science, it is hoped that during the next decade or so the number may be raised to about 150. Another feature will be the encouragement of higher agricultural education in colleges by means of grants and in other ways. There are about a dozen agricultural colleges in England and Wales, and it is hoped to bring the farmer into more sympathetic touch with them by the creation of more demonstration farms and of a keener sense of the general value of science in agriculture.

UNIVERSITY AND EDUCATIONAL NEWS

An unnamed donor has provided the funds for a new chemistry building for Cornell University, to take the place of Morse Hall, which was destroyed by fire several years ago. The sum promised is said to be about $1,000,000.

By the will of the late Professor William G. Farlow his books, papers, manuscripts etc., are left to Harvard University, to be known as the Farlow Reference Library. The sum of $25,000 is left in trust for his assistant, Arthur B. Seymour, who will enjoy the income during his life. On his death the income will be added to a gift of $100,000 previously made to Harvard, which is known as the John S. Farlow Memorial Fund. Professor Farlow further provides that on the death of his wife $100,000 be given to Harvard and added to the John S. Farlow Memorial Fund.

THE Peking Union Medical College, Peking, China, which has been built under the direction of the Rockefeller Foundation, will be open for the instruction of students in October, 1919. The school will be coeducational. There is also a premedical school offering a three years' course which was opened in 1917.

DR. HENRY KRAEMER has been appointed dean of the college of pharmacy of the University of Michigan.

C. E. NEWTON, acting dean of the school of mines at the Oregon Agricultural College since the resignation of Dean E. K. Soper several weeks ago, has been made dean of the school. He was graduated from Michigan School of Mines in 1916, and was assistant professor of engineering at the University of Washington for several years before going to the Oregon College in 1917 as associate professor of metallurgy.

DR. SUMNER C. BROOKS, of the department of tropical medicine of Harvard University, has been appointed associate professor of physiology and bio-chemistry at Bryn Mawr College.

AT the University of Virginia Dr. Graham Edgar, who was associate professor of chemistry from 1910 to 1917, has been made professor of chemistry. He received the B.S. degree from the University of Kentucky and the Ph.D. degree from Yale University. John H. Yoe has been made adjunct professor of chemistry. He holds the degree of bachelor of science from Vanderbilt University and that of master of science from Princeton University. He will receive his doctor's degree this year at Princeton.

MAJOR A. J. ALLMAND has been appointed to the chair of chemistry at King's College, University of London. Prior to his engagement in war work he was demonstrator in physical chemistry at the University of Liverpool.

COLONEL J. G. ADAMI, Strathcona professor of pathology and bacteriology in McGill University since 1892, has accepted the vice-chancellorship of the University of Liverpool.

DISCUSSION AND CORRESPONDENCE

METCALF AND BELL UPON SALPIDÆ[1]

PROFESSOR T. D. A. Cockerell has called my attention to three errors in my[2] recent discussion of the taxonomy of the Salpidæ. He writes:

There are a few points which seem to need elucidation or correction, and I venture to present them for your consideration.

1. *Apsteinia* was used by Schmeil in Crustacea in 1895.

2. *Brooksia* is uncomfortably like *Brookesia* Gray 1864 (Reptilia), but the difference of a letter saves it in my opinion.

3. *Ritteria* was used by Kramer in Arachnida in 1877.

4. You *call* the above *subgena* but *treat* them as *genera*, using binomials. This is inconsistent: you surely should get down one side of the fence.

5. You make *Salpa fusiformis* the type of *Salpa*, but this can not be, as Forskal named *maxima* in 1775, and although he recorded *fusiformis* without name, Cuvier in 1804 described it as a species. It surely is necessary to consider *maxima* the type of *Salpa*.

1. For *Apsteinia* substitute *Ihlea,* after J. E. W. Ihle, a most accurate student of the Salpidæ, who has worked upon most of the species of this subgenus.

2. The fact that two zoologists had similar names, Brooks and Brookes, should hardly prevent naming genera or subgenera after each, especially when the names so given do not resemble each other in pronunciation.

3. For *Ritteria* substitute *Ritteriella,* Dr. Cockerell's suggestion with which I concur.

4. I do not see objection to using the subgeneric name in binomial reference in a paper which deals only with one genus. Such usage aids brevity and is not in danger of being misunderstood.

5. The reference to *Salpa fusiformis* as the *typus* instead of *Salpa maxima* is clearly an error, and I do not understand how it crept into my manuscript, for in the synonymy

[1] "The Salpidæ, A Taxonomic Study," U. S. National Museum Bulletin, 100, Vol. 2, Part 2.

[2] The paper was written by me and the errors are mine, not Miss Bell's.

paragraphs under the two species I show *maxima* named in 1775 and *fusiformis* in 1804.

I wish very cordially to thank Professor Cockerell for his kindness in calling these errors to my attention and giving me the opportunity to correct them.

Dr. Ellis L. Michael questions a statement in the same paper (page 139) in which I say: "The solitary individuals (of *Thalia democratica*) lie at a considerable depth during winter, spring and early summer, coming to the surface with the aggregated zooids in the fall." He writes that the records of the Scripps Institution show "the almost complete restriction of both generations to the months of June and July. I have gone through our list of deep water collections again, and find that the statement made in my (published) report to the effect that, when all depths are considered, the species is still almost entirely restricted to the months of June and July, stands as given."

My statement quoted above was somewhat inaccurate. *Salpa* (*Thalia*) *democratica* has been found at the surface every month in the year, but in North Atlantic waters it is most abundant at the surface from July to September. When not at the surface the animals must be in deeper water. A more accurate statement than the one quoted would be that both solitary and aggregated forms of *Salpa* (*Thalia*) *democratica* are less frequent at the surface during the colder months, becoming more abundant as summer advances, and being most abundant in the late summer and early fall. The conditions off the California coast seem a bit exceptional, the time of maximum frequency of this species at the surface of the ocean being about a month earlier than in North Atlantic waters, and the species being less frequent in the winter, spring and fall than in many regions. Dr. Michael's report of its abundance in June and July and its scarcity at other times, reminds one of Agassiz's reference to the sudden appearance of this species off the New England coast and its equally sudden disappearance.[3] In few, if any, other localities have so full records of distribution of pelagic organisms been made, as off La Jolla, and it may be that similar complete records for this species for other localities would show somewhat closer agreement with the records of the Scripps Institution.

MAYNARD M. METCALF

THE ORCHARD LABORATORY,
OBERLIN, OHIO,
June 12, 1919

[3] "Three Cruises of the *Blake*," *Bull. Mus. Comp. Zool. Howard Univ.*, Vol. 14, 1888, p. 190.

"WORKING UP" IN A SWING

A CHILD sitting or standing in a swing can "work up" until he is swinging through a considerable distance. How is it possible for him, without touching his feet to the ground, to increase the extent of his swinging? As I do not recall ever seeing any discussion of this matter, the following note may not be out of place.

What the child does appears to be this: Near the end of an excursion he shifts his position so that he is on the whole farther from the axis of rotation [limb of tree, or other support], and when he is near the middle of his path he brings himself back again toward the axis. Now a shift of matter either away from the axis of rotation or toward it changes the moment of inertia about that axis, and therefore tends to change the angular velocity. In fact, unless a large torque is acting, a sudden shift must necessarily change the angular velocity. If the shift is made at a time when the angular velocity is small the change in angular velocity is small, but if the shift is made at a time when the angular velocity is large the change in the angular velocity may be considerable. Thus by moving toward the axis when near the middle of his path the child increases his velocity, whereas by moving away when near the end of the path he produces little change in his velocity.

This action may be imitated by a pendulum. Instead of keeping the length of the pendulum constant, the upper end of the suspending cord is passed over a hook and is held by a hand. The pendulum is set swinging with a small

amplitude. When near one end of the path the length of the pendulum is increased, and when near the middle of the path the length is decreased. In the course of a few swings the amplitude can be very greatly increased. The process can also be reversed and the motion of the pendulum very quickly damped.

The increase in the energy of the pendulum as its amplitude increases comes from the work done in lifting the bob when near the middle of its path. This is because a given change in the length of the pendulum involves a greater vertical displacement when the pendulum is nearly vertical than when it is much inclined to the vertical.

ARTHUR TABER JONES

SMITH COLLEGE,

A QUICK METHOD OF ELIMINATING SEED-BORNE ORGANISMS OF GRAIN

THE seed-borne diseases of grain have proved difficult to definitely eliminate from the seed. In connection with studies of hot formaldehyde as a fungicide for potato diseases it was tried for wheat scab. It was soon apparent that holding the grain in a formaldehyde solution at 50° C. as for potato scab was ineffective in killing the fungus or destructive to the viability of the seed. In order to overcome these difficulties the grain was suspended just above the formaldehyde solution one part in 240 parts of water and the temperature was raised to 98 to 99° C. and the time of exposure shortened to twenty seconds. Under these conditions all fungi in or on the seed were killed and in the majority of cases the bacteria were also eliminated. This momentary treatment did not injure the germinating capacity of the seed. The fungus flora of wheat seeds were destroyed in twenty seconds while the germinating capacity of the grain was not injured in forty seconds and only slightly at fifty. It is believed this method can be made practical for the control of scab and other seed borne diseases of grain.

I. E. MELHUS,
L. L. RHODES

IOWA EXPERIMENT STATION,
AMES, IOWA

SCIENTIFIC BOOKS

The Grand Fleet, 1914–1916: Its Creation, Development and Work. By Admiral VISCOUNT JELLICOE of Scapa. New York, Geo. H. Doran Co. 1919.

One hardly expects a critical review of a book of this character except in military journals. Yet, this book is a plain, unvarnished narrative of the meeting in battle of the two great fleets of Great Britain and Germany. Jutland was the culmination of a struggle for supremacy on the seas and back of that for world domination. It was essentially a try-out of scientific methods of annihilation as developed and adopted by the two leading nations of the world. The book might well carry as a sub-title "Science in Naval Warfare up to 1916." And therefore brief comment upon the scientific methods of the opponents is not out of place here, for we all know *now* that professional military and naval men have to lean and lean heavily upon non-official scientific men.

The battle of Jutland as described in this book reminds one of a Homeric conflict, for just when some great captain had closed with his antagonist, the watching gods, disguised as mists, fogs and poor visibility intervened and separated the fighters. Much as we would like to compliment the British, the palm for preparation and scientific attainment must go to the Germans. The British had more ships and more guns; but the Germans had better range finders, better telescopic sights, better mine fields, better torpedoes, better submarines and more of them, better overhead observation facilities and a Zeppelin or two.

The Grand Fleet (British) appears to have made use of a single seaplane which flew very low, yet whose observations as Vice Admiral Beatty says, were "of distinct value."

The German battleships were of greater displacement than contemporary British ships and carried a greater weight of armor. Nine of the British dreadnaughts had protection to the main deck only, while all of the German dreadnaughts had side armor to the upper deck. The Germans had a delay action fuse

which, combined with a highly efficient armor-piercing projectile, insured a bursting of the shell *inside* instead of outside the protecting armor. They also had decided advantages in under-water protection of their capital ships, and so when one of their ships was mined or torpedoed, it did not necessarily sink, while the British ships when thus hit, rarely survived. The Germans had star-shells, unknown at that time to the British. They could locate the British destroyers at night without revealing their own position. The German search-lights were more powerful and their control more effective. Lights and guns could be brought to bear upon a sighted vessel with a minimum of delay. They had also a better system of director firing of the secondary armaments.

How then did the Grand Fleet manage to do as well as it did? Probably because officers and men possessed enduring courage and that fine spirit of determination to take any odds and do their duty. We believe that our own Navy has much of the same spirit.

It is not to be supposed that the German High Command did not know of the inferior scientific equipment of the Grand Fleet. They were fully aware of the departmental methods and official inertia that can operate so effectively to bar progress and arrest development. Admiral Jellicoe places no blame for this failure to keep the Grand Fleet properly equipped, yet his manifest apprehension when relieved of command of the Fleet to accept promotion as First Lord of the Admiralty indicates the probable seat of the trouble.

In the book there are constant references to weather interference with naval operations. It is invariably offered as justification for change of course or failure to complete some projected movement. One wonders if it ever occurred to the High Lords of the Admiralty that a decisive conflict would take place some day between the fleets in the North Sea, and that the issue might hang upon the weather, as indeed it did? And was there a comprehensive study of the aerography of that ocean available? *There was not.* The highest meteorological authority in Great Britain informed the writer, that "the English left the study of the weather of the North Sea to the Germans."

In the memorandum issued to the fleet after the Jutland battle it is stated that "weather conditions of a highly unfavorable nature robbed the Fleet of that complete victory which was expected by all ranks . . ." and King George visiting the fleet on June 15, said to the captains, "Unfavorable weather conditions and approaching darkness prevented that complete result which you all expected; but you did all that was possible in the circumstances. . . ."

It is an open question whether the weather prevented a victory. Fog and mist may have helped the British, for certainly the punishment inflicted by the German battleships, when visibility permitted, was severe.

In connection with the weather conditions there is one interesting little sidelight on Lord Kitchener's death. A northeast gale prevailed at Scapa Flow, on June 5 when K.K. on his way to Archangel visited the Grand Fleet. It had been intended that the ship carrying him and his escort should depart up the eastern side of the Orkneys; but in conference, owing to the gale, it was decided that the *Hampshire* should take the west or lee side. By the time the ship was outside, the center of the storm had passed and the wind had backed to the northwest. So there was no lee on the west side of the Orkneys and when the accident occurred the sea was so high that no help could be rendered. In brief a faulty forecast of the weather sent England's great captain and those with him to their doom.

On p. 380 it is stated that "gunfire and under-water explosions were heard at intervals during the night and curiously enough the under-water explosions, four or five in number, were quite clearly recorded on a barograph in the *Malaya*, a ship well placed for the purpose as she was in the rear. There is little doubt that these records showed the explosion of our torpedoes against enemy ships." The natural question is, what kind of a barograph was it, and did any of the other barographs, assuming there were some, show similar

records? Evidently there was no attempt at sound ranging.

The typographical work on the book is excellent except that the photographs, charts and diagrams are poorly lettered and not up to the rest of the book.

A. M.

SPECIAL ARTICLES

VARIATIONS IN THE ELECTRICAL POTENTIAL OF THE EARTH

AT a meeting of the Academy of Science of St. Louis, held on March 17, the writer presented diagrams representing variations in gravitational attraction between the masses of the Cavendish apparatus in the second story of the physics building at Washington University.

This apparatus is composed of a shield in which the smaller masses are suspended on a bi-filar suspension of silk fibers. The top, bottom and ends of this shield are of wood, covered within and without with tin-foil. The sides are of sheet metal, clamped to the wood frame by bars of wood and the joints sealed with wax. The wood clamps are covered by tin-foil. The whole is then surrounded by two end caps of metal which meet at the middle of the shield and are sealed together with tin-foil. The position of the suspended masses is determined by a telescope and scale in the usual manner. The mirror is observed through a narrow slit in the two metal screens which surround the suspended masses, and which is closed by a strip of glass sealed to the inner sheet of metal. The suspended masses are electrically charged by means of a wire armed with a pin which is thrust through a glass tube which is passed through a small opening in the end of the shield. When connected with the electrical machine in an adjoining room the air within the shield and the suspended masses were charged. This operation was made to come about gradually by having a gap armed with pins in the line leading to the machine. In some cases the suspended masses would swing into contact with the metal sheets forming the sides of the screen. It was arranged that they should be deflected towards the large masses. It was found that on withdrawing the glass tube and pin and closing the opening in the screen with tin-foil, the small masses could be liberated with an initial velocity approaching zero, by connecting the large masses and screen directly with the machine terminal, eliminating all gaps in the line. The impression thus created was that gravitational attraction was thus diminished until the torsional effect of the bi-filar suspension could detach the small masses from the screen, to which they were held by an electrical attraction.

After the suspended masses had come to rest in the center of the screen, which was usually on the following day, the large masses were directly connected with a large copper rod on the outer wall of the building, which served as lightning protection for the building. This rod was the ground connection for a steel tower on the roof of the building, which formerly was part of a system for wireless telegraphy. The top of this tower is 100 feet above the ground. This tower and the earth replaced the electrical machine, in the electrification of the large masses.

On clear days when there was practically no wind, the gravitational attraction of the large masses for the suspended masses has sometimes been diminished, until it has apparently become a repulsion. All artificial heat was cut off from the room, so that its temperature increased during the day not more than two or three degrees centigrade. The temperature of the air in contact with the large masses was under constant observation, the recording being made by means of a telescope. The temperature could be read accurately to tenths of a degree Centigrade, and hundredths of a degree could be estimated with fair precision.

When the masses were not in connection with the lightning rod, the rise in temperature during the day caused a very slow increase in the reading which determined the position of the suspended masses. This change was due to convection currents within the shield surrounding those masses.

These convection effects have been very carefully examined. They are distinctly appreciable when the temperature of the room

increases by two degrees in six or seven hours. They are very marked when a door opening into the hallway is opened for four or five minutes, allowing warmer air to enter the room. The entrance door used when this work is being done is in an adjoining room. When a window is raised for a few minutes, allowing colder air to enter, a sudden decrease in the scale reading results. The convection effect increases as the rate of change of temperature increases.

When the suspended masses have been positively charged, and the large masses have been connected with the lightning rod marked effects have been observed on clear days when there was little or no wind. Sometimes the effect was to eliminate convection effects. In all cases there was an apparent decrease in gravitational attraction. The maximum decrease was usually in the afternoon at about three or four o'clock. The decrease varied from twenty-five to near two hundred per cent. In other words, gravitational attraction was apparently converted into a repulsion.

These results seem to indicate that there is a daily variation in the electrical potential of the earth. The atmosphere, ionized by solar radiation, acts inductively upon that part of the earth which is exposed to sunlight. Lightning flashes from cloud to cloud or from clouds to earth furnish abundant evidence that there are also local variations in the potential of the earth. There is no reason why we should not continue to assume the potential of the earth to be zero, as we assume the level of the ocean to be zero in altitude, but there is evidence that there is a condition of matter such that its electrical potential may be defined as zero absolute. It is the condition or potential of two masses having a like potential due to charges upon them when their gravitational attraction for each other is a maximum.

It seems very probable that the free terminal of a machine having the other terminal grounded in a pond of water, may be at times, nearer to a potential zero absolute, than the grounded terminal, when the machine is in active operation. This would fully account for different results obtained when the electrical machine is used in the electrification of the large masses. These results appear to furnish a complete explanation of the phenomenon known as St. Elmo's fire.

FRANCIS E. NIPHER
WASHINGTON UNIVERSITY

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY. IV

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

W. E. Henderson, *Chairman*

W. A. Patrick, *Secretary*

Action of perchloric acid on metals and non-metals: H. H. WILLARD and A. H. HUISKEN.

Perchloric acid as an oxidizing agent in the determination of chromium and vanadium: H. H. WILLARD and W. E. CAKE.

Perchloric acid as a dehydrating agent in the determinination of silica: H. H. WILLARD and W. E. CAKE.

The arrangement of electrons in atoms and molecules: IRVING LANGMUIR. Starting from Rutherford's and Lewis' theory and from chemical data, a theory of atomic and molecular structure is developed in which the electrons are symmetrically arranged about the nucleus in concentric shells. From some simple postulates the broad features of the physical and chemical properties of all the elements (including eighth group and rare earths) are derived. There follows a new and rational theory of valency called the octet theory, identical with the ordinary theory for organic compounds and for inorganic compounds giving Werne's theory as a special case. The theory also explains the magnetic properties of the elements.

Preferential catalysis and the purification of hydrogen: H. S. TAYLOR.

New measurements on the direct synthesis of ammonia (lantern): L. H. ADAMS.

Application of the thermionic amplifier to conductivity measurements (lantern): L. H. ADAMS and R. E. HALL.

Electrometric titrations, with special reference to the determination of ferrous and ferric iron (lantern): J. C. HOSTETTER and H. S. ROBERTS. Conditions are given under which very small, as well as large, amounts of ferrous and ferric iron can be readily determined. Ferrous iron is titrated directly with potassium dichromate (0.002 N to 0.10 N) following the change in potential against

a calomel electrode; ferric iron is reduced with stannous chloride after which the excess of the reducing agent and the ferrous iron are titrated together, the curve of potential against quantity of dichromate showing two points of inflection between which is the amount of dichromate corresponding to the iron. Small amounts of ferrous iron can be determined directly in ferric salts and similarly ferric iron directly in ferrous salts: other applications of the method are given.

The effect of strain on solubility (lantern): J. C. Hostetter. It is possible that fluctuating temperature and, perhaps, some indirect effects brought about by pressure may account for the solidification of crystals compressed in contact with their solution by loosely fitting pistons—as found by James Thomson, Le Chatelier and Spring—without the necessity of postulating large increases in solubility due to non-uniform pressure. In preliminary experiments, individual crystals were subjected to stress at constant temperature by direct loading, and the effect on the concentration of the surrounding solution studied, by measuring the electrical conductivity. No change in concentration was found. The test was sufficiently sensitive to indicate that the effect of non-uniform pressure is much less than that produced by the same pressure acting uniformly. However, in another series of experiments in which an unloaded crystal was placed alongside a loaded crystal, the former grew at the expense of the latter, showing that a very slight increase of solubility was produced by the stress. The method of loading the crystals has a large influence on the effects found, thus indicating the importance of the stress distribution. The experiments of Becker and Day on the linear force of growing crystals are cited as indicating the stability of a crystal in its solution, even when subjected to pressure. In their experiments loaded crystals were found to lift the load during growth, although the pressures on the supporting edges of the crystals were finally of the order of magnitude of the crushing strength of the crystal. The evidence so far obtained indicates that the effect of strain on solubility is a second order effect.

A method of growing large perfect crystals from solution (lantern): Roy W. Moore. This method consists briefly of placing or hanging a small seed crystal or several of them in a nearly-saturated solution, cooling the solution until it is very slightly supersaturated, and maintaining a state of slight supersaturation by slowly cooling the solution, with the temperature regulated within very narrow limits. Under these conditions, the seed crystals will build out to form perfectly developed, clear crystals, and these will continue to grow clear and perfect as long as a state of slight supersaturation is maintained. By this method, crystals of Rochelle Salt have been produced that are three inches or more long and two inches thick, perfectly clear and with all surfaces and angles perfectly developed. This method should be applicable to any substance which crystallizes from solution either in water or other solvents, provided the solubility varies considerably with the temperature.

Action of nitrogen and hydrogen mixture on steel at high pressure and temperature (lantern): R. O. E. Davis. When subjected to an atmosphere of nitrogen and hydrogen at high pressure and temperature of 500° C. for some weeks carbon steel shows a marked change in physical characteristics; it is probable that a compound is formed between the iron and the gases.

Comparative tests of palau and rhotanium ware as substitutes for platinum laboratory utensils (lantern): L. J. Gurevich and E. Wichers. A series of tests has been carried out at the bureau to determine the suitability of the palau and rhotanium alloys as substitutes for platinum laboratory ware. The tests were of two types, the aim being to determine the resistance of the materials to chemical reagents, and their behavior on heating. These tests indicate that rhotanium "A" ware is superior to platinum ware both of high (2.4 per cent.) and low (0.6 per cent.) iridium content in respect to its resistance to loss on heating. The losses on treatment with acid, after heating, are about equal. Grade "A" ware compares favorably with platinum in resistance to boiling hydrochloric and hydrofluoric acids, to boiling 20 per cent. sodium hydroxide, and to fusion with sodium carbonate in a muffle, and with potassium pyrosulphate. It is superior to platinum in resistance to the action of boiling sulphuric acid, and inferior in its resistance towards boiling concentrated and dilute nitric acids, boiling 10 per cent. ferric chloride solution, and for fusions with sodium hydroxide. The only objection that may be raised to its use is the rather low melting point of the alloy, which makes it impossible to blast or strongly heat the ware without melting it. As far as resistance to loss in weight on heating to 1,200° C. is concerned, rhotanium "C" and palau wares are about equal, if not slightly superior, to platinum ware containing 0.6 per cent. iridium. They are surely superior to

platinum ware containing 2.4 per cent. iridium. Palau and rhotanium "C" behave towards reagents in about the same way as rhotanium "A," except that they are not suitable for potassium pyrosulphate fusions and are inferior to grade "A" for sodium hydroxide fusions. The only striking distinction between rhotanium "C" and palau is the latter's slight superiority in the case of the potassium pyrosulphate fusions. Palau and both grades of rhotanium may all be used to advantage in the electrolysis of chemical solutions, but only as cathodes. As anodes the alloys are worthless. It is believed that in order that the above tests may indicate the true merit of the alloys, information should be available as to the behavior of these wares in actual laboratory service. Unfortunately the authors have very little of such information at their disposal, and suggest that any further available information of this nature, both favorable and unfavorable, be communicated to the Bureau of Standards.

Hydrogen overvoltage; applications to reduction, metal corrosion and deposition (lantern): D. A. MacInnes and A. W. Contieri. MacInnes and Adler have advanced a theory in which hydrogen overvoltage is related to the surface energy necessary to form the evolved bubbles. The theory requires that the overvoltage increase with a decrease of the external pressure, and *vice versa*, a prediction verified in some unpublished work by Goodwin and Wilson. In this paper it is shown that, in acid solutions, reduction by metals is accelerated, corrosion of metals is decreased, and the electrolytic deposition of metals is made more efficient, by reducing the external pressure.

The ternary system CaO-MgO-SiO_2 (lantern): John B. Ferguson and H. E. Merwin. A brief discussion of the experimental methods, followed by a general survey of the liquidus-solidus relations. Several new compounds will be described; the solid solutions of different types which occur will be touched upon and the effect of solid solutions upon inversion temperature will be mentioned.

The influence of chemical composition on the birefringence in strained glass (lantern): Erskine D. Williamson. All glasses to be used for optical instruments must be tested for the presence of internal strains. The only convenient method of accomplishing this is to measure birefringence as observed between crossed nicols. It is therefore necessary to know how the observed birefringence for a given amount of strain depends upon the composition of the glass which is being used. Figures are presented for the eight types of optical glass made by the Pittsburgh Plate Glass Company during the war.

The determination of oxygen by the copper-ammonia-ammonium chloride reagent: W. L. Badger.

Fluidity and hydration (lantern): Eugene C. Bingham.

The preparation of cyanogen chloride: W. L. Jennings and W. B. Scott. Nearly quantitative yields (98 per cent.) of cyanogen chloride may be obtained conveniently by passing chlorine into finely powdered sodium cyanide, containing 2 per cent. of water, suspended in carbon tetrachloride and kept cooled to — 3° C. At the end of the operation the product is distilled off and by redistillation over mercury is obtained pure. This method appears to be an improvement on the earlier methods in which mercuric cyanide was used as initial material, and on the later methods in which chlorine was passed into aqueous solutions of hydrocyanic acid or alkaline cyanides.

Electrolytic preparation of permanganates: Charles Hecker.

A study of the constant-boiling mixture of hydrochloric acid and water: Marion Hollingsworth.

A holder for spools of iron wire for standardisation: Marion Hollingsworth. The holder is made from sheet metal and carries the spool supported in a stoppered bottle. The construction is such that the wire may be conveniently drawn out as desired without exposing that which is left to the corroding atmosphere of the laboratory.

A new buret support: Marion Hollingsworth. This support is designed to carry a buret attached to a supply bottle. It has the advantage that the buret's height may be varied without any of the graduations being obscured.

Charles L. Parsons,
Secretary

(*To be concluded*)

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CONTENTS

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METHODS OF SECURING BETTER COOPERATION BETWEEN GOVERNMENT AND LABORATORY ZOOLOGISTS IN THE SOLUTION OF PROBLEMS OF GENERAL OR NATIONAL IMPORTANCE[1]

THE Zoological Division of the Bureau of Animal Industry of the Department of Agriculture is particularly concerned with that branch of zoology commonly known as parasitology. The Animal Husbandry Division of that Bureau has a special interest in genetics, but as this is a subject that is receiving a good deal of attention from university zoologists at the present time the opportunities for cooperation with respect to the zoological work of the Animal Husbandry Division are perhaps better than they are with respect to the work of the Zoological Division. In any case it is not my purpose to consider the question of cooperation on problems in the field of genetics and my remarks on this occasion are made with reference to the possibility of securing closer cooperation between universities and the Department of Agriculture in research work in the field of parasitology.

The work of the Zoological Division consists chiefly in the investigation of the parasites of domestic animals and of those trans-

[1] A symposium before the American Society of Zoologists, held at Baltimore on December 26, 1918, Professor C. E. McClung presiding, included papers and discussions as follows: Representing the Bureau of Entomology, Dr. L. O. Howard. Discussion by J. G. Needham. Representing the Bureau of Fisheries, Dr. Hugh M. Smith. Discussion by Dr. H. B. Ward. Representing the Bureau of Animal Industry, Dr. B. H. Ransom. Discussion by Dr. Herbert Osborn. Representing the Bureau of Biological Survey, Dr. E. W. Nelson. Discussion by Dr. R. K. Nabours. Relation of the Council of National Defense and the National Research Council to the Advancement of Research, Dr. John C. Merriam.

missible from domestic animals to man with the purpose of establishing methods for their control and eradication. The welfare of the live-stock industry, the public health, and other large national interests are dependent in no small measure upon the suppression of diseases caused by animal parasites as well as those of bacterial origin. The results of scientific research in the field of parasitology have in repeated instances supplied the knowledge necessary to bring about the eradication or control of disease. Many problems in this field remain to be solved. From a practical standpoint therefore parasitology is a highly important branch of zoology. It has, however, not been popular among American zoologists and there are few universities in this country where graduate students have favorable opportunities for acquiring the working knowledge essential for the practical parasitologist. Parasitology of course is a very special branch of zoology and it is not to be expected nor is it desirable that a large number of specialists should be trained for research in parasitology, but I believe that the present and future needs of the country are sufficient to justify more attention to this subject by zoologists than has heretofore been given. The Zoological Division has always had difficulty in securing the services of properly qualified men to carry on its work. The neglect of parasitology by zoologists is no doubt largely responsible for this condition. Low salaries and other objectionable features of government service, real and imagined, may have contributed to the difficulty of maintaining our scientific staff. University professors however, and especially subordinates to the heads of departments of universities have not fared better with respect to salary than men in corresponding positions in scientific branches of the government service, and the red tape and other troubles that worry government scientists are no more disagreeable than some of the things endured by the scientific man in the university.

In the face of the evident fact that parasitology is a subject with which American zoologists have comparatively little to do at present, what are the possibilities of cooperation between the universities and the Bureau of Animal Industry with respect first to the training of parasitologists for government service and second to research in university laboratories on problems of parasitology likely to yield results of direct or indirect value to the work of the Bureau of Animal Industry in the suppression of parasitic diseases?

Although extensive cooperation can scarcely be undertaken under existing conditions it should nevertheless be possible to bring the universities and the Bureau of Animal Industry into closer contact with resultant benefit to both. It is hardly worth while at present to speculate upon the extent to which cooperation between the two may be developed in the future as it will necessarily be dependent upon the course of development of the general policy of cooperation in scientific work between the universities and the government. I shall therefore only venture a couple of suggestions as to what might be done immediately toward securing more effective cooperation than has existed in the past. These suggestions should be taken as suggestions only and not as the fixed policy of the Bureau and Department with which I am associated, although it may be stated that there is nothing particularly novel about them and I see no reason why they should be objectionable from a departmental standpoint. One plan that has occurred to me is essentially simple, namely, to give a limited number of graduate students specializing in parasitology the opportunity of studying in the laboratory of the Zoological Division for a limited period of time in each case. Much could not be promised in the way of personal instruction and such students therefore should have demonstrated their ability to work more or less independently. Ordinarily perhaps not more than one student at a time could be thus accommodated. It is likely that arrangements could be made for the payment of a salary in return for what service the individual was able to render the division during the time he spent in the laboratory, so that his laboratory experience need cost him nothing. A plan of

this kind would naturally involve some trouble from the standpoint of administration of the work of the division, but I believe the fact that it would give the chief of the division an opportunity to become acquainted with students of parasitology who might later desire to enter the service and thus enable him to form an opinion as to their capabilities and suitability for the work would offset any inconveniences resulting from their presence in the laboratory. The student himself would not only profit from what knowledge of parasitology he was able to gain during his stay in the laboratory, but he would also be able to determine better than he might otherwise whether he would care later to take a position in the division.

As to possibilities of cooperation between university departments of zoology and the Bureau of Animal Industry in research work on problems relating to parasitic diseases it would be quite feasible in some cases for the bureau within certain limits to assist financially or otherwise in investigations likely to yield results of value to the live-stock industry of the country. The exact nature of cooperative arrangements which might be made in any instance would depend largely upon the special conditions of the individual case, and nothing would be gained by discussing plans of cooperation at this time. Without going into details I may therefore limit myself to an expression of the willingness of the bureau to cooperate with university zoolgists in investigations in the field of parasitology in any way possible.

My remarks have been very brief but if the suggestions I have offered are of any value more elaborate discussion can be left for other occasions, if they are not the brevity of their presentation is not to be regretted. In any case I am very glad to have had this opportunity of speaking a word for practical zoology, of expressing the belief that it deserves more attention from the zoological profession in this country than it has hitherto received, and of pointing out certain ways by which it may be possible to bring about better cooperation between the universities and the government in zoological research.

B. H. Ransom

Bureau of Animal Industry

Dr. Ransom's paper suggests several topics for discussion and is certainly opportune.

It is probably true that the subject of parasitology has been neglected in large measure in our colleges and universities but I can hardly agree that it is due to lack of interesting phases of the subject. No doubt tapeworms are less attractive than birds or butterflies, but when we take into account their remarkable adaptations and the complex adjustments involved in their alternations of host they offer most fascinating points for biologic study, and to this may be added their economic interest. In my own experience I have usually found that students respond very promptly to discussion of these aspects of parasitic biology.

As to the dearth of workers there is something to be said in the matter of demand. In my own experience I have often had students who became interested in the subject but the great majority of our university students have to meet the practical problem of entering on work that will bring them a living income and it has usually been the case that when this feature was met the man would find more attractive openings in teaching or research in other lines.

As to practical lines of cooperation I think Dr. Ransom has made a suggestion that is practicable and quite feasible. Advanced students and especially graduates working on theses or dissertations might very profitably be assigned for a specified time to work in the bureau laboratories or for field work, perhaps utilizing their summer vacations as is done in geology or entomology with perhaps joint supervision of bureau and university department so that there may be opportunity for university credits.

Courses in parasitology have been offered in a number of institutions especially in recent years but I am not posted as to the extent of enrollment. However, any figures for recent years would be of little value as showing drift to these courses. I believe some of the men

with this training have found place in government service along lines related to their specialty but how many I could not say.

Teachers may very profitably emphasize the features of parasitism that afford examples of biologic adaptation and in medical and agricultural applications and this should serve to aid in the application of the bureau results.

I believe a very useful aid in this work would be for the bureau to furnish to the laboratories, willing to cooperate, a condensed manual for the more essential technique in the preparation of material for study and keys for identification of species most commonly met with in laboratory work.

The laboratory guides of Braun & Lühe: Stitts; and Herms, and Pratt's indispensable "Manual of Invertebrates" are of course available and are no doubt very generally used but they are more likely to fit into special or advanced courses and a simple hand-book, in mimeograph form if desired, available for use in some of the more general courses would, I believe, help to stimulate interest.

Possibly an outline of a course in parasitology arranged by a conference between representatives of bureau and university teachers might help especially if such outline indicated what special problems could be worked to advantage in any particular locality. Also the employment of advanced students in the routine duty of collecting or preparing material for bureau use might be possible. A circular letter from the bureau to university departments suggesting work that might be done would be helpful, and I believe that suggestions to teachers as to the matter and form for best presenting to students and thereby to a larger public, the results of the bureau work might be of advantage.

Specific training of specialists for the bureau service might be facilitated by an understanding as to probable employment of men willing to enter the field as their life work.

I do not understand that the demand is wide enough, for the immediate future at least, to warrant many schools making a specialty of the subject but certainly a few schools with proper facilities might very profitably offer distinct courses preparing for such work and prospective students in this line could then be steered to such schools from other departments not emphasizing this phase of zoology.

Another thing which, speaking from the university side, seems to me worth considering would be the preparation of a moderate number of representative species of parasites for demonstration purposes in classrooms or laboratories or even the accumulation of certain abundant forms sufficient for laboratory dissections or study. The bureau doubtless has a large accumulation of duplicate material from which it would be possible to supply material where desired with perhaps the agreement that the department so supplied should contribute other material as it might become available.

While it often happens that a quantity of specimens of some particular species is found in great abundance I believe we will all agree that the securing of such material in condition and quantity for laboratory purpose is more difficult than for most other groups.

Perhaps my suggestions may seem to be rather one-sided, involving mostly assistance from the bureau to the university laboratories, but I believe that the bureau will find the university men ready and willing to cooperate and that they will welcome definite suggestions as to ways and means by which such cooperation may be established.

Herbert Osborn
Ohio State University

THE THREATENED EXTINCTION OF THE BOX HUCKLEBERRY, GAYLUSSACIA BRACHYCERA

The box huckleberry (*Gaylussacia brachycera*) is a rare and beautiful American shrub which is in process of extinction. It is declared by Mr. Harlan P. Kelsey, the well-known landscape architect, of Salem, Massachusetts, that for many woodland situations it is the most beautiful native evergreen ground cover known to him. The biological problem is to preserve the wild plant from extinction and at the same time to bring it into horticultural use.

Two years ago the writer, desiring to ex-

amine the plant in its wild state, sought to find out its known localities by consulting the larger American herbaria. He was surprised to find specimens from only two localities, one in Perry County, Pennsylvania, the other in Sussex County, Delaware. The original locality assigned to the plant by Michaux in 1803, namely, near Winchester, Virginia, is almost certainly a mistake, and its occurrence at the localities in Bath County, Virginia, Greenbrier County, West Virginia, and Polk County, Tennessee, in which it is alleged to have been found, appears not to be substantiated by specimens in any American herbarium.

On July 13, 1918, under the guidance of Mr. Kelsey, the writer visited the Pennsylvania locality. The plant is confined to a single patch extending for a distance of over 400 yards along the slope and shoulder of a timbered west-facing hill. It occupies an area of about eight acres. The soil is a loam of buff-gray color, weathered from an underlying shale of similar color. It has no other supply of water than direct rainfall. Overlying the loam is a layer of upland peat a few inches in thickness, such as commonly characterizes an area of acid-soil dry-land vegetation.

The character of the vegetation is indicated by the following list of its commoner plants.

Trees:

Scarlet oak (*Quercus coccinea*),
White pine (*Pinus strobus*),
White oak (*Quercus alba*),
Chestnut (*Castanea dentata*),
Chestnut oak (*Quercus montana*),
Red maple (*Acer rubrum*),
Black gum (*Nyssa sylvatica*),
Dogwood (*Cornus florida*).

Shrubs:

Box huckleberry (*Gaylussacia brachycera*),
Laurel (*Kalmia latifolia*),
Wintergreen (*Gaultheria procumbens*),
Dry-land blueberry (*Vaccinium vacillans*),
Trailing arbutus (*Epigaea repens*),
Lowbush blueberry (*Vaccinium angustifolium*),
Juneberry (*Amelanchier canadensis*),
Pink azalea (*Azalea nudiflora*),
Sweet fern (*Comptonia peregrina*),
Pipsissewa (*Chimaphila umbellata*),
Spotted pipsissewa (*Chimaphila maculata*),
Witchhazel (*Hamamelis virginiana*).

There is no indication from the soil, moisture conditions, exposure or accompanying vegetation that there are any special conditions on this area, different from thousands of other areas in the Apalachian region, to explain the presence of the box huckleberry in this particular spot.

Over the whole area the root mat of the box huckleberry is practically continuous. Only one isolated piece was seen outside the main patch, and that was on a steep grassy slope immediately north of the main area, where farm cultivation had been begun but later abandoned. This plant is undoubtedly a piece of the original patch, cut off from the rest by the cultivation but left alive because the cultivation had been discontinued.

The abrupt termination of the patch, unaccompanied by any change in the soil, and the absence of isolated patches were most amazing. In the two hours we spent at the place we sought for the explanation, and I think we have it. But before it is outlined, let me present additional evidence of the completeness of the plant's isolation. On the north and much of the east and west sides the patch is bordered by cultivated fields and a road. The natural extension of the patch in these directions is therefore impossible. On the south end, however, the present margin of the patch is located amid natural surroundings. It runs through the timber in a sinuous but definite line which coincides with no topographic or other natural barrier. All along this line the patch is actually progressing and extending by sending out rootstocks which throw up new stems at the end of each year's growth.

For a distance of 125 yards at the southern end of the west side of the patch, the mat ends abruptly at the bottom of the hill at a natural barrier, a slender woodland streamlet, so low at the time of our visit that in several places no water was flowing over its wet gravel bed. For much of the distance the brooklet has slightly undercut the hill, so that the edge of the root mat hangs suspended a few feet

above the water. At some points, however, the root mat comes down to the water's edge, but although suitable ericaceous soil occurs in many places on the other side of the brooklet, sometimes no more than three paces away, and other ericaceous plants occupy both banks, the box huckleberry has never jumped this tiny barrier.

The theory I advance is that the whole patch has spread by the root from a single plant. If this theory is correct the plant is undoubtedly more than a thousand years old. If it started in the middle of the present area and grew at an average rate of six inches a year, a liberal estimate judging from the observed length of its annual rootstock increment, its advance to its present front-line position would have required 1,200 years. The widely heralded but half legendary thousand-year-old rosebush of Hildesheim is easily outlived.

As additional evidence that the whole of the eight-acre patch consists of a single plant I may say that notwithstanding the most painstaking search we found no seedlings. Many small tufts were examined, but every one proved to be attached by a rootstock to an older piece. The base of the hill on which the patch occurs had been undercut for more than 250 yards by a public road. The steep bank between the road and the hill, formed many years ago in the grading of the road, furnishes at several points good germination beds for the seeds of the overhanging plants. In a careful search along the whole bank not a seedling of the box huckleberry was found, although the bank did bear seedlings of the closely related plants, laurel, dry-land blueberry and trailing arbutus.

The plant was in fruit at the time of our visit, the delicate light blue berries being particularly charming in their setting of dark green box-like foliage. A resident of the neighborhood told us that the plant fruited every year. Why then are there no seedlings?

I have recorded elsewhere, in an account of my blueberry breeding experiments, that individual blueberry plants, close relatives of the huckleberries, are partially or completely sterile to their own pollen. The seeds from such a pollination, if any are secured, are sterile, or if they germinate the seedlings are feeble and never develop into strong plants, even under the protecting care of cultivation. If this Pennsylvania box huckleberry patch consists of only one plant its seeds might be expected to be sterile or of feeble germination. And this in fact was found to be true. On examination about 90 per cent. of the seeds proved to be empty shells. Only about 10 per cent. contained endosperms. On November 20, 1918, 1,600 seeds were sowed in eight boxes in a suitable soil of peat and sand and subjected to different temperature treatments. From this sowing only three seeds germinated, and the three seedlings are feeble. From other sowings made on July 20, 1918, a somewhat better but still very poor germination was secured, and the largest of the plants, at the age of six months, are less than an inch high.

Further evidence that the whole patch consists of one plant is afforded by its botanical characters. With the exception of differences in size and vigor, due apparently to differences in the amount of nutrition, the plant is remarkably uniform over the whole area. This uniformity is particularly noticeable in the fruit, which has a curious obovoid-pyriform shape. While individual plants of other species of blueberries and huckleberries sometimes have this shape, a comparison of the fruit of many individuals of any species shows variation to other shapes, such as spherical, or even depressed. The uniformity in the form, and in the color also, of the berries throughout this patch is the same sort of uniformity that one finds in fruits that have been reproduced by cuttings, budding or grafting from a single parent plant.

On the theory that the perpetuation of the species through seeds could be brought about only by finding another plant, for cross pollination, an endeavor was made to relocate the Delaware station. Dr. C. S. Sargent informed me that in company with Mr. William M. Canby, the original discoverer, he had tried several years ago to find the spot, but without success, and he believed the plant had been exterminated. Nevertheless I sent a botanist

in November, 1918, to find the plant if possible, but after two days' search he was unable to locate it.

The situation had become acute, for a firm of nurserymen had taken away a truck load of plants from the Pennsylvania locality in 1918, and the doom of the species in a wild state appeared to be sealed unless we could find another plant, for the Pennsylvania plant was the only one actually known. Therefore when Mr. E. T. Wherry, the chemist, offered to make a further search for the Delaware area I gladly assented. To his acute insight into the soil habits of rare and fastidious plants he added further information that he found in Philadelphia regarding the location of the old Canby station, and after three days' systematic search, in early March of the present year, he found it.

From Mr. Wherry's report of his rediscovery the following paragraph is drawn:

This colony of the box huckleberry is situated on a northwest sloping bank about eight feet high. It covers an area but twenty feet square, the plant forming a practically pure stand in the center but thinning out rapidly in all directions. No seedlings could be found, all the stems apparently being connected with one another by running rootstocks so that really only a single plant is represented. A few stems extend into the wet, peaty material bordering the marsh but most of the colony is growing in dry, sandy upland peat made up of leaves of pine, oak and laurel, on the steep slope. The plants immediately associated, as far as could be determined at the time of the visit, are:

Trees:
- Pond pine (*Pinus serotina*),
- Red cedar (*Juniperus virginiana*),
- Red oak (*Quercus maxima*),
- Holly (*Ilex opaca*).

Shrubs:
- Inkberry (*Ilex glabra*),
- Laurel (*Kalmia latifolia*),
- Sweetbells (*Eubotrys racemosa*).

Vine:
- Greenbrier (*Smilax rotundifolia*).

Only five localities, widely distant, have been recorded for this plant and its existence in only two of these at the present time has actually been confirmed. The question why the species has become so nearly extinct has not yet been answered and perhaps never will be answered conclusively. I wish to call attention, however, to the probability that if these two northeastern patches consist of a single plant each, as it appears they do, it is likely that they were originally chance seedlings from seeds carried by birds beyond the original main range of the species. For if these patches were remnants of a former widespread continuous range, and climatic changes had destroyed the species over the rest of its range, each of these remnants would almost certainly have consisted of more than a single plant. I am impressed also by the possibility that a plant in process of extinction may have been killed over most of its original range by some particularly destructive fungus or insect, and that the reason of the preservation of healthy remnants may be that they were beyond the range of the destructive enemy. Possibly, too, the remnants were immune to the destroying agent. The present ravages of the chestnut blight (*Endothia parasitica*) give an idea of what may have happened to thousands of plant species now extinct or known only from distant remnants.

However, the box huckleberry is not extinct, and we are hoping for its rejuvenation through vigorous seedlings. In order that my colleagues may share in the excitement I may add that portions of the Pennsylvania and Delaware plants have been brought together at Washington, cross pollinations have been made, and fruit has set but is not yet ripe.

I trust I shall be pardoned if I add to this article an unessential postcript, the excuse for which is more biographical than biological. In April, 1846, Asa Gray, the most distinguished of American botanists, writing to his colleague, John Torrey, said:

A Mr. Baird, of Carlisle, Pa., called on me yesterday, evidently a most keen naturalist (ornithology principally), but a man of more than common grasp. He talked about an evergreen-leaved Vaccinium, which I have no doubt is V. brachycerum, Mx., that I have so long sought in vain.!

This was the first meeting between Dr. Gray and Spencer F. Baird, second secretary of the Smithsonian Institution, who at that time, an ardent young naturalist of twenty-three, was professor of natural history at Dickinson College, Carlisle, Pa. The friendship thus begun between Gray and Baird was intimate and lifelong, lasting for more than forty years, and it had great constructive influence in the advancement of natural history in America. It was clearly Baird's discovery of the box huckleberry, the very same patch in Pennsylvania about which I have been writing, that chiefly drew the two men together at their first meeting, and since this charming little thousand-year-old lady of the forest has done so much for American naturalists, the least we can do in return is to try to keep her living forever.[1]

FREDERICK V. COVILLE

VINAL N. EDWARDS

WORKERS in science who are wont to visit Wood's Hole during the summer months will miss the familiar figure and kindly greeting of one who has been identified with every piece of faunistic work that has been carried on at the Fish Commission Laboratory since the time of Baird, and one whose wide range of activity, intimate knowledge absolute reliability and willingness to serve have made him a most valuable source of information and assistance to those connected with the "Marine Laboratory" since the time of its foundation. Vinal N. Edwards, in the continuous service of the government for over sixty years, died on April 5, 1919, and leaves vacant a place in the vital affairs of Wood's Hole that can not be filled.

If a young enthusiast felt that by early rising he might steal an advantage over other collaborators, his arrival at "the commission" found Vinal already hard at work. If a trip was made to the gulf stream, Vinal was the man that knew when, where and how to gain profit out of the expedition. If it were a quiet night, ideal for "skimming," it was Vinal's skiff that was moving silently among the slicks. Throughout the day, in the corridors of the laboratories, on the wharf or at the traps—it made no difference where—probably no sentence was more frequently heard than "I don't know, ask Vinal."

Untaught in the modern conception of the word, courteous in his manner, unmentioned in "Who's Who," unrecorded in "American Men of Science," here was a man remarkably well informed, courteous and friendly in his association with men, well known to a multitude of educators, and one upon whom many of the foremost workers in biological science relied for information and advice. It is probable that hundreds of new species have resulted from his activities as a collector. In Verrill's report on the invertebrates of Vineyard Sound, his name is repeatedly mentioned. Smith's paper on the fishes of the Wood's Hole region would have been impossible without his help, and those who were associated in the preparation and publication of the "Biological Survey of the Waters of Wood's Hole and Vicinity" frequently stated that one of the motives which originally prompted this work was the "desire to incorporate in a permanent form the valuable but unpublished data in the possession of this indefatigable collector and observer."

In order that the life and work of Vinal N. Edwards may not become forgotten, testimonials from several sources have been collected, and bound copies of these will be deposited in the Library of the United States Fish Commission, in the Library of the Marine Biological Laboratory at Wood's Hole, in the Library of the National Museum, the Li-

[1] Gray's first account of the box huckleberry, in which from Baird's specimens he was able to assign the species to its correct genus, Gaylussacia, was published in 1846 in his "Chloris Boreali-Americana," pp. 54–55 (*Mem. Amer. Acad.*, ser. 2, vol. 3). The quotation from the letter to Torrey cited above is from Jane L. Gray, 1893, "Letters of Asa Gray," p. 343, where the date assigned to the letter is October, 1846. By reference, however, to W. H. Dall, 1915, "Spencer Fullerton Baird, a Biography," pp. 132–134, it is clear that the meeting took place, and the letter was written, in April, 1846.

brary of the American Museum of Natural History and the Library of Congress.

HERMON C. BUMPUS

SCIENTIFIC EVENTS

THE LISTER INSTITUTE[1]

THE Lister Institute is unique among the medical establishments of London, because it is an independent organization endowed by private benefactors. The only comparable institution is the London School of Tropical Medicine, which, however, is in the enjoyment of government support. The Lister Institute is one of the schools of the University of London, admitted under the statute which empowers the senate to admit any institution within the prescribed area founded for the promotion of science or learning to be a school of the university for the purpose of research or the cultivation of any special branch of science or learning. Its director, Dr. C. J. Martin, F.R.S., is professor of experimental pathology in the university, while several members of its staff are readers or recognized teachers in the university. But its connection with the university is otherwise shadowy and its affairs are managed by a governing body which includes Major General Sir David Bruce, K.C.B., F.R.S. (chairman), Professor F. W. Andrewes, M.D., F.R.S., Professor W. Bulloch, F.R.S., Sir James Kingston Fowler, K.C.V.O., and Professor E. H. Starling, C.M.G., F.R.S., There is also a council containing representatives of the members of the Institute and of many learned bodies.

The report to be presented at the annual general meeting gives an account of the various activities of the institute during the year, and contains a section in which its future general policy is discussed. A great deal of the time of the staff of the institute—which, owing to the war, was much diminished—was given to routine bacteriological examinations for the London County Council and other public bodies, and the production of serums and vaccines for the War Office and the Government of Egypt. But some of the work done for the War Office has reached out to research, as, for instance, investigations made by Dr. Arkwright and Mr. Bacot as to the virus of trench fever and typhus fever, and the transmission of these diseases by lice. Miss Muriel Robertson has continued researches upon anaerobic bacteria of wounds and the preparation of standard samples of the toxin of *Vibrion septique* which have been used in preparing and standardizing the serums issued to the army from the serum laboratories of Messrs. Burroughs, Wellcome and Co. Much of present knowledge of the pathogenic anaerobes has been gained since the beginning of the war, and in its acquisition Miss Robertson, who is secretary of the anaerobic committee originated by the Medical Research Committee, has taken a prominent part.

In another direction researches stimulated by the war have yielded results of permanent importance to physiology and general medicine—and indeed to sociology and statecraft also. Dr. Harden and Dr. Zilva have made a series of investigations into the properties of accessory food factors and the effects of the deprivation of them on various animals. A related research was that conducted by Dr. Harriette Chick, at the request of the military authorities, into the cause of scurvy; it was eventually expanded to include certain other deficiency diseases. The research demanded the greatest care in the adjustment of the diets and the feeding of the animals, and the help of many volunteer workers was enlisted. This inquiry has had many parts, but those concerned with the quantitative determination of the relative antiscorbutic efficiency of natural foodstuffs, and with the loss of antiscorbutic value during the drying of vegetables, are now practically complete; work is still in progress with regard to the preservation of lemon juice and root vegetables, and as to the antiscorbutic and growth-promoting properties of cow's milk, with special reference to infant feeding. The novel feature of the investigations has been the attempt to get a quantitative estimate of the amount of accessory food facts in various foodstuffs, the first step being to determine experimentally

[1] From the *British Medical Journal*.

for each substance the minimum daily ration which will protect the experimental animal. A committee on accessory food factors, with Professor Hopkins as chairman and Dr. H. Chick as secretary, has been sitting during the year, and has prepared a monograph to meet the needs of the general scientific and medical reader.

SCIENCE IN AUSTRALIA

THE newly founded Commonwealth Institute of Science and Industry, Melbourne, has begun the publication of a monthly journal entitled *Science and Industry*. The editorial foreword says:

No competent scientific investigator need fear the coming of the institute. It will not attempt to do work that others are doing already. There is more than sufficient work for all. No one needs to look round for a job. They are everywhere at hand. While there is still dust in Sydney's streets, or smoke issuing from the chimney stacks at the factories at Footscray, while there is waste timber being eternally burnt around the saw-mills of the west, while the molasses expressed from the sugar-cane of the north still finds its way down to the sea, who can deny the width of the field for scientific investigation? While the rich lands of Queensland are continually being given over to the prickly pear, and arable areas of Victoria to St. John's wort, while artesian water ceases to flow, or the bores to corrode, while stock die of strange diseases in the night, and their young perish before birth, while there are still mineral treasures that have not yet been exploited by the prospector, while air transport is still with us an undeveloped means of locomotion, while a thousand and one articles of daily use are still being imported from foreign lands that could easily be manufactured by our own people, who will say that there is no room for science?

Hitherto in Australia, and in most other English-speaking countries, the scientist is only now beginning to get back some of his own. In the past there has been observable a certain suspicion of science. The primary producer used to regard the man of science as a dreamer or at best a theorist. They talked of Collins-street farming. The scientific man, on his part, had little respect for those who allowed their actions to be hampered by the ideas of their grandparents. But gradually it was seen by producers that the man of science had something to teach them if, they were only prepared to listen, and if he was willing to express his thoughts in every-day language. The man on the land no longer despises science as he did a quarter of a century ago—at least, the more progressive do not. The manufacturers are not precisely in the same plight. With some few and notable exceptions, they have been inclined to ignore the lessons of science. The scientists themselves are somewhat to blame for this, or, at any rate, they have themselves to thank. Business men have one test of value, and that is cost. Scientists who love their science place it above money. Much of the most valuable scientific work done in the world has been done for a pittance. The reward of the investigator was not necessarily expressed in the augmentation of his banking account. Business men could not understand this. Services that could be had cheaply were nasty. If they were valuable, they would be much sought after in the market. So argued these men of affairs, and this was the basis of those advertisements asking for the services of fully-qualified chemists at £200 a year or less. These bad old days must end if science is to come into her own. In the field of science the laborer is worthy of his hire.

The institute is the youngest department of the commonwealth government. It is not yet old and effete, with a large number of its officers eagerly looking for the retiring age. It represents the young commonwealth, youthful and virile, and realizes, as it has been expressed, that "the frontier of knowledge is the starting point of research."

SIGMA XI AT SYRACUSE UNIVERSITY

THE Society of Sigma Xi at Syracuse University has elected as officers for the ensuing year the following: *President,* Edward D. Roe, Jr.; *Vice-president,* C. C. Adams; *Secretary,* Geo. T. Hargitt; *Treasurer,* Henry F. A. Meler. During the past year the following scientific program has been presented by members of the society:

November 18. Edwin F. McCarthy. Occurrence of knots and spiral in Adirondack red spruce.

Carl J. Drake. Notes on *Nezara viridula*, a serious plant pest in the south.

December 13. R. S. Boehner. Gas warfare.

E. N. Pattee. The outlook for chemical industries in the United States.

January 10. T. C. Hopkins. Exploring and

prospecting for oil in Wyoming and Kentucky.

Chas. H. Richardson. Some results of recent geological research in Vermont.

February 6. H. S. Steensland. The action of benzol on animals.

Frank P. Knowlton. The electrocardiogram, with demonstration.

March 14. E. D. Roe, Jr. The irreducible factors of $1 + x + x^2 + \cdots + x^{(n-1)}$.

R. R. Tatnall. The production and measurement of low pressures.

April 11. L. M. Hickernell. The habits and structure of the 17-year cicada.

H. F. A. Meier. The fixation of atmospheric nitrogen by plants.

May 9. Louis Mitchell. The use of diagrams in the solution of hydraulic problems.

Rich D. Whitney. The destruction of underground structures by electrolysis.

THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY IN BRITISH GUIANA

AFTER two years of temporary suspension on account of the war, the Tropical Zoological Station of the New York Zoological Society, in British Guiana, is again proceeding with its various activities. Director William Beebe now has with him Inness Hartley, research associate, Alfred Emerson, research assistant, and John T. Van, artist. In a short time two visiting zoologists will arrive at the station for the pursuit of special studies.

In order to live and work in close proximity to the jungle and the river life of British Guiana, the old station at Kalacoon was vacated, and the new one was planted in the government Penal Settlement, at Katabo. There, in an ideal spot, a commodious laboratory and dormitory have been developed, and an extensive program of investigation has been laid out. Three tropical rivers of considerable importance, the Essequibo, Cuyuni and Mazaruni, render the whole western half of British Guiana available to the station near the meeting-place of their waters. The Mazaruni Rapids are eight miles above the station.

A garden has been planted, and Indian hunters bring to the table of the station varied supplies of tapir, deer and agouti meat and fish. Animal life in close proximity to the station is abundant, and the choice of subjects for investigation is fairly bewildering.

Again has the government of British Guiana been most liberal in promoting the objects of the station, and the Zoological Society looks forward with lively interest to the year's record of results.

SCIENTIFIC NOTES AND NEWS

THE RT. HON. JOHN WILLIAM STRUTT, LORD RAYLEIGH, the great English physicist, died on July 1, at the age of seventy-six years. His eldest son is the Hon. Robert John Strutt, professor of physics in the Imperial College of Science, London.

WESLEYAN UNIVERSITY, at its recent commencement, conferred the degree of doctor of science on Edward Lee Thorndike, '96, professor of psychology at Teachers' College, Columbia University; Frank Bowers Littell, '91, astronomer, Naval Observatory, Washington, D. C., and George Arthur Burrell, recently in command of United States Army Chemical Service.

AT the commencement of the University of Vermont the degree of doctor of letters was conferred on Dr. Liberty Hyde Bailey, formerly director of the college of agriculture of Cornell University, and the honorary degree of doctor of science on Dr. Marshall Avery Howe, curator of the museums of the New York Botanical Garden. Dr. Bailey delivered the commencement address, taking for his subject, "The aspiration to democracy."

THE honorary professional degree of master of horticulture has been conferred upon Edmund H. Gibson, of the U. S. Bureau of Entomology, by the Michigan Agricultural College.

THE agricultural building at the Kansas State Agricultural College has been named Waters Hall in honor of Dr. Henry Jackson Waters, former president of the college, now managing editor of the *Kansas City Weekly Star*.

DR. D. T. MACDOUGAL, director of the department of botanical research, Carnegie Institution of Washington, was elected a corresponding member of the Société Nationale

d'Acclimatation de France, at the meeting of May 25, under the presidency of Minister Lebrun.

The title of Commander of the Order of the Crown of Belgium has been conferred on Dr. W. J. Holland, director of Carnegie Institute, Pittsburgh, in recognition of the "devotion shown by him to the cause of Belgium."

Major W. H. Eddy, of the section of food and nutrition of the Surgeon General's Office has recently returned from abroad. After the departure of Major P. A. Shaffer, Major Eddy was in charge of the work of the section in France. He is now temporarily on duty at the Surgeon General's Office. Major F. L. Scott, of the section of food and nutrition of the Surgeon General's Office has also returned from abroad and received his discharge from the army.

President Kenyon L. Butterfield, of the Massachusetts Agricultural College, has returned from France.

Captain Lawrence J. Cole, professor of psychology at the University of Colorado, has received his discharge from the army and has returned to the university.

Professor Max Ellis, of the department of biology of the University of Colorado, who has been on leave of absence for two years engaged in government service, has resigned to accept a permanent government position.

We learn from the *Journal* of the American Medical Association that Dr. Alexander C. Abbott, of the University of Pennsylvania, who recently returned from France, where he served with the Medical Corps of the U. S. Army, has been nominated for a position on the Philadelphia Board of Health. Dr. Frank C. Hammond, who was appointed to fill the vacancy, insisted on resigning the post that Dr. Abbott might be reappointed to his former position.

The Harvard Corporation has made the following appointments on the Harvard Cancer Commission: Dr. Robert B. Greenough, director, and Drs. Channing C. Simmons, secretary (both of Boston); Roger Pierce, treasurer; James H. Wright, Boston, pathologist; William Duane, research fellow in physics; William T. Bovie, research fellow in biology; Henry Lyman, Boston, research fellow in chemistry, and Ernest W. Goodpasture, Boston, research fellow in pathology.

Dr. Winfield Scott Hall, for more than twenty years a member of the faculty of Northwestern University Medical School, Chicago, has been appointed to take charge of the newly organized department of social hygiene of the Presbyterian Board of Temperance and Moral Welfare.

Dr. Charles J. Galpin, professor of agricultural economy in the college of agriculture of the University of Wisconsin, has been appointed economist in charge of farm-life studies of the United States Department of Agriculture.

Mr. Charles Snyder, head keeper of reptiles in the New York Zoological Park, has been made director of the Buffalo Zoological Gardens.

Mr. F. Flippance, at one time a temporary assistant in the herbarium at Kew, has been appointed assistant curator of the Botanic Gardens, Singapore.

Dr. J. E. Kirkwood, professor of botany in the Montana State University at Missoula, has been granted leave of absence for a year and will work in the University of California laboratories. During his absence the department will be in charge of Assistant Professor Paul W. Graff.

Dr. K. Sato, assistant professor of agriculture in the University of Tokio, is studying problems of farm management and agricultural economics in the United States.

H. S. Gale, of the U. S. Geological Survey, has been making a survey of the potash situation in Alsace.

W. R. Ingalls has retired from the editorship of the *Engineering and Mining Journal*, but will continue as consulting editor. He has resumed practise as consulting engineer with offices in New York.

PROFESSOR J. F. KEMP has recently found among other stored articles in the department of geology of Columbia University a notebook of the late Professor John Strong Newberry, containing notes in French taken by him while a student, and covering the lectures on botany delivered by Professor Brongniart in Paris in 1849 and 1850. Through Professor Harper, Professor Kemp has transmitted this very interesting document to the New York Botanical Garden for preservation, and it has been added to the library.

DR. C. L. MARLATT, assistant chief of the Bureau of Entomology, and chairman of the Federal Horticultural Board, gave an address to the Entomological and Zoological Seminar of the Kansas State Agricultural College on May 19, on some work of the Federal Horticultural Board.

DR. ALBERT R. MANN, dean of Cornell College of Agriculture, delivered the address at the forty-ninth commencement of the Massachusetts Agricultural College at Amherst, on June 24. He spoke on "The place of the trained man in agriculture."

THE Croonian Lecture on the biological significance of anaphylaxis was delivered on May 29, before the Royal Society, by Dr. H. H. Dale, F.R.S., director of the biochemical and pharmacological department of the Medical Research Committee.

SIR ARTHUR NEWSHOLME gave a public address on the evening of June 20, at the University of Toronto, on "Some problems of preventive medicine of the immediate future." Sir Arthur was the guest of honor at a dinner given by Dr. Edmund E. King, Toronto, president of the Academy of Medicine.

FATHER WALTER SIDGREAVES, S.J., director of the Stonyhurst College Observatory, known for his contribution to stellar spectroscopy and other work, died on June 12, in his eighty-second year.

THE four hundredth anniversary of the death of Leonardo da Vinci was celebrated at Naples on May 2. The *British Medical Journal* states that an address was delivered by Professor Filippo Bottazzi. The great artist was an enthusiastic anatomist. He began his studies in the Hospital of Santa Maria Nova at Florence in 1489, when he was in his thirty-seventh year, and continued them at Milan in the Ospedale Maggiore and the Collegio die Fisici, and afterwards at Rome in 1513 till they were forbidden by Leo X., on a denunciation of body-snatching made by some German enemies. He dissected more than thirty bodies of men and women of various ages, and his observations were collected in one hundred and twenty books; much of the manuscript has been lost, and the drawings designed to illustrate the text of a great work on anatomy to have been written in conjunction with Marc' Antonio della Torre, the famous professor of Pavia, lay forgotten in the Ambrosian Library at Milan, and afterwards in the Royal Library at Windsor, until they were discovered in 1902. They are now in course of publication.

THE faculty of the North Dakota Agricultural College, organized under the name College Teachers Organization, voted on June 9 to apply for a charter in the American Federation of Teachers. Eighty per cent. of the teaching staff are members of the new organization.

THE annual general meeting of the Society of Chemical Industry will be held in London on July 15–18, under the presidency of Professor Henry Louis. *Nature* states that on July 15 there will be a conference at the Mansion House, when addresses will be given by representatives of the Inter-Allied Conference. Sir William J. Pope, chairman of the Federal Council for Pure and Applied Chemistry, will open the conference. The subjects of other conferences will be: Power Plant in Chemical Works; Empire Sugar Production; Dyestuffs, Synthetic Drugs and Associated Products; The Chrome Tanning Industry; and Recent Developments in the Fermentation Industries. A reception will be held at the British Scientific Products Exhibition, Central Hall, Westminster, on July 17.

WASHINGTON UNIVERSITY SCHOOL OF MEDICINE has received a grant of $5,000 to be used

for the investigation of hypertrichiasis, from a person whose name is for the present withheld. A committee in charge of the grant has been appointed, consisting of the dean, Dr. G. Canby Robinson; Dr. M. F. Engman, of the department of dermatology, to whom the grant was proposed, and Dr. Charles H. Danforth, of the department of anatomy, who will carry on the investigation which will be chiefly in the fields of anthropology and heredity.

A "Roosevelt Institute of American Family Life," to be developed in connection with the eugenics record office of the Carnegie Institution, in Washington, has been proposed to the Roosevelt Permanent Memorial National Committee by the Eugenics Research Association of Cold Spring, Long Island. The association in outlining the project explains that it owns eighty acres of land in Roosevelt's own voting district, and has already laid the foundation for the study of the factors controlling American family life. In the announcement, which proposes the erection of the memorial institute at Oyster Bay, the association declares: "This memorial institute will strive to advance those ideas of responsible and patriotic parenthood for which Theodore Roosevelt so valiantly battled." In addressing the national committee the association wrote: "We respectfully call your attention to the following factors which contribute to the fitness of this suggestion: The Roosevelt memorial should, like the man in whose memory it is built, battle for the advancement of the eugenical ideal in American family life. It should be located in Roosevelt's own neighborhood. The safety of the foundation fund could be absolutely secured by placing it as trust with the Carnegie Institution of Washington. Its proximity to New York City makes the Oyster Bay neighborhood an exceptionally fitting place for the institute."

UNIVERSITY AND EDUCATIONAL NEWS

Harvard University is bequeathed $100,000 for the study of methods to reform and cure criminals and mental defectives by surgery under the will of Dr. J. Ewing Mears.

In accordance with the will of the late Clementine C. Conkling, real estate in the city of Omaha to the value of approximately twenty-five thousand dollars has been bequeathed to the college of medicine, University of Nebraska, Omaha.

The Goldsmiths' Company has offered the sum of £15,000 to London Hospital for the endowment of a chair of bacteriology, to be known as the Goldsmiths' Company's chair of bacteriology.

The Utah Agricultural Experiment Station recently established a department of human nutrition. R. L. Hill, Ph.D. (Cornell), formerly of the Maryland Agricultural Experiment Station and first lieutenant in the Sanitary Corps of the Army, has been appointed head of the department with Blanche Cooper, B.S., formerly nutrition expert for the Utah Agricultural College Extension Division, associate.

Dr. Harry Woodburn Chase, professor of psychology, has been elected president of the University of North Carolina.

Dr. A. F. Kidder has resigned as professor of agronomy in the college of agriculture, Louisiana State University, to accept a position as agronomist and assistant director of the State Agricultural Experiment Station at Baton Rouge.

Nathan Fasten, B.S. (C. C. N. Y. '10), Ph.D. (Wisconsin, '14), has been promoted to the rank of assistant professor of zoology at the University of Washington, Seattle.

Professor T. Brailsford Robertson, professor of biochemistry in the University of Toronto, has been appointed to succeed the late Sir Edward C. Stirling as professor of physiology in the University of Adelaide, South Australia.

Mr. W. L. Bragg has been appointed to the Langworthy chair of physics in the University of Manchester in succession to Sir Ernest Rutherford.

DISCUSSION AND CORRESPONDENCE

THE DISCOVERY OF CACULUS

To THE EDITOR OF SCIENCE: The writer desires to call attention to certain disclosures here pointed out for the first time, whose conclusions are decisive in the matter of the celebrated controversy between Newton and Liebniz, regarding the discovery of calculus. It is admitted that Leibniz was in full possession of his calculus, at the time of his second visit to London, in September, 1676, and that during the week in London, he made copious extracts from Newton's "De Analysi Æquationes Numero Terminorum Infinitas," which was in the hands of Collins, where it had been placed by Barrow in 1669, with the consent of Newton.[1] Besides containing the binomial theorem, expansions of trigonometric functions, etc., it was a complete treatise on fluxions. Found among Collins's papers after his death, it was published in 1711.

Leibniz's first information *from Newton* that this work existed, and where it was to be found, came from Newton's second letter of October 26, 1676, which reached Leibniz some months later in Germany. I quote the "Encyclopedia Britannica" (Inf. Calc.) as to the contents of this letter:

> Newton proceeds to state that about 1669 he communicated through Barrow to Collins a compendium of his method subsequently called "the method of fluxions," with applications to areas, rectification, cubature, etc. *In* this letter, however, he gave no explanation of this method, carefully concealing its nature in an anagram of transposed letters. . . .

Leibniz's reply to this letter has been termed one of "noble frankness" in contrast to Newton's secrecy. This frankness, however, did not consist in informing Newton of the week but recently spent with Collins, in careful examination of the very compendium to which he referred, and that his anagram was useless. On the contrary, Leibniz renewed statements of ignorance of Newton's method, and with seeming frankness, imparted his calculus to Newton in every detail, thereby laying the foundation of a plot to deprive Newton of all credit, whose subsequent details were carried out on a timed schedule.

Thus, on the first publication of a work on fluxions by Newton in 1704, an unsigned and unfavorable review in the "Leipzig Acts" for 1705, stated that Newton uses and always has used fluxions for the differences of Leibniz. A few years later, Leibniz, who was the author of this indirect charge, made it still clearer in a letter to Count Bathmar, which was published, stating that Bernouilli had written to him that Newton had apparently fabricated his calculus after having seen his own. Later than this, again, a letter was distributed over Europe, making the same direct charge, but without containing the name of its author, printer or place of publication.

From Leibniz's examination of Newton's compendium of fluxions on his second visit to London, it is absolutely certain that he possessed personal knowledge that these infamous charges against Newton were false.

It must be explained how Leibniz knew of the existence of that compendium in Collins's hands when he went to London, out of his way from Paris to Hanover, and how he knew that it contained what he wished to see. Newton's first letter to Leibniz, June 13, 1676, gave all the important theorems on series which were contained in that compendium, although his letter neither stated this fact, nor gave explanations. In his reply of August 27, 1676, Leibniz expressed great interest, and asked ~~for~~ their explanation and then shortly after went to London and read all about them, the opportunity for this journey being a request from the Duke of Hanover to return to Germany.

The only reasonable supposition is that Leibniz had seen this manuscript on his first visit to London, in 1673, and thus knowing of its existence, and that it contained these series, the new interest which they aroused caused the second visit, for the purpose of re-reading them in the light of an improved mathematical knowledge.

The probability of the truth of this supposition is increased when we take into account the character of the man and the cir-

[1] Cajori, "A History of Mathematics," p. 230.

cumstances which surround the first visit. He was continually employed throughout life in typical German propaganda, and was accustomed to political deceit. In 1669, under the guise of a Catholic Polish nobleman, he wrote a tract which undertook to mathematically demonstrate to his supposed countrymen, the Poles, that it was for the best interests of Poland to elect the German candidate for their throne. The political mission which brought him to Paris in 1672 was to secure France as an ally of Germany in a proposed war of conquest against the Turk, the bait to France being the possession of Egypt, "one of the best situated lands in the world." This project was finally laughed from the court of Louis XIV.

While in Paris, Leibniz corresponded with Oldenberg and Collins. The former was Secretary of the Royal Society of England, and had in charge all papers and manuscripts of the society. He was for many years a German agent in London whose services as secretary were given without pay. Confined in the Tower as a spy in 1669, the Royal Society adjourned its meetings until his release.[2]

Collins was the closest friend of Newton, and spent his entire time in obtaining the latest mathematical information and in corresponding with mathematicians about it. These two men, Oldenberg and Collins, always appear as instruments of Leibniz in his dealings with London affairs and with Newton, but all communications seem to have passed through Oldenberg's hands.

After 1669, when Collins obtained the compendium of fluxions above mentioned, there was much correspondence about fluxions between Newton, Collins and other mathematicians, and on December 19, 1672, Newton sent a letter to Collins which was designed to explain fluxions to any intelligent person, with one illustrative example, which Collins immediately began to communicate to all of his correspondents.

Leibniz was in London, January 11, 1673. and remained until March following. Application for membership in the Royal Society had preceded him, and he attended all of its meetings, read mathematical papers before it, and made claim to a differential method for series as his own invention, which Pell identified as the method of Mouton, a Frenchman, very much to Leibniz's discomfort. He had discussions with Oldenberg and Collins regarding series, and we must remember that the latter possessed, in Newton's compendium on fluxions, the latest and most remarkable series of the time. That Leibniz had free access to the manuscripts in the hands of these men, and read them, would appear from his notes of this visit, discovered in 1890, in the royal library at Hanover. These show extracts from Newton's "Optics," and from other authors, and a remarkable absence of notes on mathematics, his chief subject of interest at the time.

Returning to Paris in March, Leibniz placed himself under the guidance of Huygens in higher mathematics, and began the development of his calculus. It was well in hand by December, 1675, and the question arose, how to deal with Newton. The plan adopted was to have Newton informed that Leibniz had heard that he had a method for series, tangents and the like, and requested information about it, as he had one of his own. It required the united persuasions of Oldenberg and Collins, and an appeal that it was for the honor of England, to overcome Newton's objections and bring about the first letter of June 13, 1676, already mentioned. The ostensible purpose of the correspondence is to learn Newton's method, yet he held Newton's compendium of it in his possession for a week, the following September, and since its pages were opened freely to him at that time, it is constructive proof that they were as freely open to him for the two months in 1673 that he was in London.

The sudden death of Oldenberg in 1677 prevented an answer to the letter of "noble frankness." but when the "Principia" was published in 1687, Newton inserted a scholium containing the statement that a letter from Leibniz had shown that that distinguished

[2] See Weld, "History of the Royal Society," Vol. 1, pp. 201, 259.

man had fallen upon a method which scarcely differed from his except in its forms of words and symbols.

It is not known how far Collins was in the confidence of Leibniz, but it has been noted that following Collins's death in November, 1683, appeared the *first publication* of Leibniz's calculus, in the "Leipzig Acts" for 1684, essentially as it was given to Newton in 1677.

Additional force is given to the supposition that Leibniz saw Newton's compendium in 1673 by the similarity of the circumstances to those which relate to German propaganda as it has been disclosed by the recent war, a similarity so striking, that one hardly realizes that the period concerned is practically two and one half centuries nearer the origin of such methods. But the letter of "noble frankness" with the unquestioned facts which throw light upon it, are alone sufficient to bar Leibniz from the honor of an independent discoverer, for no other reason than that, as we say in the law, he does not come into court with clean hands.

ARTHUR S. HATHAWAY
PURDUE UNIVERSITY

THE POOR DIENER

How many of us have not felt as we closed an article that we may have thought good, perhaps expressing perfunctory thanks to our patron or instructor or some other figure in the seats of the mighty who took a few minutes time to send us some preparations or cultures prepared by some one else in his laboratory, that there was a hardworked, somewhat pathetic humbler figure back of it all to whom our thanks are far more due than to any of these?

When you take down from the shelf a carefully cleaned, carefully sterilized, cotton-plugged flask and fill it up for your own purposes, and then cheerfully discard it and take another because you got in a tenth of a centimeter too much, when you finish up a couple of hours brisk work and then carry out a trayful of pipettes to the "dirtroom" to be washed up, and leave around a staggering array of dirty glassware too bulky to bother to take out yourself, when you pile up on the sterilizing bench a great lot of used, gone and forgotten cultures for some one else to autoclave, then remember the poor diener.

When you toss over a foul sample of sputum with a "Here Jim, stain this up and look for the bugs," or hack out a bloody mess of tissues from a dead guinea pig and hand them over with a curt "Shove these into Zenker, George, and run 'em through as fast as you can," give credit where credit is due. These are not operations that can be carried on by any old man in the street; these are true science.

Dozens of procedures which we learned with difficulty in school days, we turn over to dieners and technicians, who learned the art from other dieners and technicians and carry it on in a clean-cut mechanical way better than we could do ourselves. God help science if all the dieners should unionize and go on a strike to-morrow.

E. R. L.
SARANAC LAKE

SCIENTIFIC BOOKS

RECENT PALEOBOTANY IN GREAT BRITAIN

THE following survey of paleobotanical researches published in Britain during the war is necessarily superficial; it is, moreover, obviously impossible to draw a clearly defined line between work done in the period immediately preceding the outbreak of hostilities and work completed since August, 1914. No mention is made of papers which, though primarily concerned with recent plants, include references to extinct types. In spite of the fact that national work of one kind or another has absorbed, wholly or in part, energies normally devoted to scientific research the record of achievement amply justifies the statement that the progress of paleobotanical enquiry has not suffered any serious check. Much has been done towards quickening the spirit of research in pure science as well as in relation to problems of great economic importance: the foundations of paleobotanical knowledge have been considerably strengthened and, with the access of greater opportunities and revived interest in research which we confidently expect in the days to come, the results gained during the period of storm and

stress will unquestionably exercise a stimulating and directive influence upon future investigations.

Through the death of Mr. Clement Reid (December, 1917) paleobotany has lost one of the ablest and most careful observers in a neglected field of British botany, namely, the investigation of the composition of European floras subsequent to the advent of the flowering plants as the dominant class. In his later work he had the benefit of the assistance of his wife by whom, it may confidently be expected, questions connected with the origin of the British flora will be further elucidated. Dr. Newell Arber, who died in June, 1918, was one of the most indefatigible and enthusiastic students of ancient floras, particularly those of Paleozoic and later Mesozoic age. He accomplished much in a comparatively short life and by his whole-hearted devotion to research exercised a wide influence upon younger men. Miss Ruth Holden, though an American citizen, left her paleobotanical work in this country at the end of 1916 to join a British medical unit in Russia where she died in April, 1917. By her death paleobotany lost an exceptionally gifted and promising student.

Books.—The second part of "The Cretaceous Flora"[1] by Dr. Marie Stopes, a volume of a series of British Museum Catalogues of the fossil plants in the national collection is devoted to an account of Lower Greensand (Aptian) plants, principally Conifers and extinct types of Cycadophyta. The introductory chapter includes an interesting sketch of the general facies of Lower Greensand floras and a discussion on the climatic conditions under which the plants lived. A remarkable new genus (*Colymbea*) of Cycadophyta is described and new types of dicotyledonous wood. The author's work affords striking evidence of the highly specialized structure of some of the oldest dicotyledonous trees of which we have any detailed knowledge. Volume III. of "Fossil Plants,[2] a text-book for students of Botany and Geology" by the writer of this article published in 1917 continues the account of Pteridosperms and Cycadofilices begun in Vol. II. and deals with recent and fossil Cycadophyta, the Cordiatales, and fossil gymnospermous seeds. The concluding volume has been printed and will be published as soon as circumstances permit.

Papers.—1. *Pre-Carboniferous Plants.* One of the most important paleobotanical contributions of recent years, a paper of exceptional interest, is the memoir by Dr. Kidston and Professor Lang[3] on a new genus of plants, *Rhynia Gwynne-Vaughani,* beautifully preserved as an almost pure growth in beds of chert in the Old Red Sandstone of Aberdeenshire. The chert consists of a series of peat beds which were periodically inundated and eventually covered by a layer of sand. The silicified peat is almost entirely composed of the prostrate stems and rhizomes of the leafless and rootless *Rhynia.* This oldest land plant of which the internal structure is at all fully known consisted of a branched underground rhizome attached to the soil by rhizoids bearing occasionally forked, slender, leafless aerial branches. The vegetative organs bore small hemispherical protuberances some of which developed into adventitious branches. The reproductive organs are represented by elongate isosporous synangia probably borne at the end of the main axes. A new group, the Psilophytales, is instituted for this exceptionally interesting plant which is compared with *Psilotum* and with the Devonian *Psilophyton princeps.* Dr. Arber and Mr. Goode[4] record the occurrence of a few fragmentary impressions of land plants from Devonian rocks of North Devon including specimens of slender repeatedly forked axes with terminal cupule-like organs which they refer to a new genus *Xenotheca* believed to represent the fertile shoots of a Pteridosperm.

[1] "Catalogue of the Mesozoic Plants in the British Museum" (Nat. Hist.), The Cretaceous Flora, Pt. II., London, 1915.

[2] "Fossil Plants," Vol. III., Cambridge, 1917.

[3] *Trans. R. Soc. Edinburgh,* Vol. LI., Pt. III., p. 761, 1917. See also British Assoc. Report, 1916, p. 206.

[4] *Proc. Cambridge Phil. Soc.,* Vol. XVIII., Pt. III., p. 89, 1915.

The Devonian species belong to the oldest land-flora so far described from English strata. A paper by Messrs. Don and Hickling[5] gives by far the best account we possess of *Parka decipiens*, a problematical Old Red Sandstone discovered in 1838 and referred to different positions in both the animal and vegetable kingdoms. It occurs, in the form of flat circular or oval flattened mummified bodies enclosing numerous circular groups of spores, in the lower beds of the Caledonian Old Red Sandstone and in passage beds between the Old Red and Silurian. The authors make out a good case for its inclusion in the Thallophyta as an extinct type with Algal affinities. Mr. Don, a student of unusual promise, obtained a commission in the early days of the war and died at Salonika in April, 1916.

2. *Carboniferous Plants.*—Additions have been made to our knowledge of Carboniferous floras by several authors. Dr. Kidston[6] published in 1916 the first of a projected series of papers on plants from the Scottish Coal Measures in which are described two new species of *Sigillaria*, two new types of *Sphenopteris*, and a new species of seed referred to the genus *Lagenospernum*. The same author[7] has described several plants from the Forest of Wyre coalfield and from the Tetterstone Clee Hill coalfield. Dr. Arber[8] in a paper dealing with plants from the Red Clay series and the Middle Coal Measures of the Staffordshire coalfield proposed a new generic name, *Calamophloios*, for casts and impressions of Calamite stems in which the external surface and not the surface of the pith-cast is preserved. These papers on Carboniferous floras supply important data towards a more complete classification of coal-bearing strata in Britain on the basis of the fossil plants. Miss Lindsay[9] contributes new facts in a short account of the method of branching and the phenomena of branch-shedding in *Bothrodendron*.

Dr. Scott in an interesting sketch of the forests of the coal age[10] discusses the evidence afforded by paleobotanical investigations on the conditions under which the plants grew; he draws attention to the high degree of organization exhibited by Paleozoic species, a fact which has not hitherto been sufficiently realized in discussions of problems connected with evolution. The same author[11] has published a valuable and comprehensive account of the genus *Heterangium*, one of the best known examples of the very important extinct Paleozoic group of pteridosperms, plants with fern-like foliage-bearing seeds and possessing anatomical characters denoting a close affinity to gymnosperms. He institutes a new subgenus *Polyangium* to include several species characterized by compound leaf-traces and other distinctive features in contrast to another set of species, in which the leaf-trace is single in origin, referred to the subgenus *Eu-Heterangium*. The Polyangium forms indicate a closer relationship between the Lyginopteridese and the Medulloses and Calamopityese than has hitherto been suspected. This paper is an admirable example of the importance of revising from time to time in the light of fresh discoveries our knowledge of extinct genera. Dr. Scott[12] has recently described a new species of another Carboniferous genus founded on petrified stems, *Mesoxylon multirame*, characterized by the presence of many axillary shoots and other morphological features. A preliminary account is added of a small stem associated with *Mitrospermum* seeds which it is believed may belong to Mesoxylon. Dr. Nellie Bancroft's careful re-investigation of Williamson's *Rachiopteris cylindrica*[13] from the Lower Coal Measures of Yorkshire reveals the existence of two types of this fern which she regards

[5] *Quart. Jour. Geol. Soc.*, Vol. LXXI., Pt. IV., p. 648, 1917.

[6] *Trans. R. Soc. Edinburgh*, Vol. LI., Pt. III., p. 709, 1916.

[7] *Ibid.*, Pt. IV., p. 999, 1917.

[8] *Phil. Trans. R. Soc. London*, Vol. 208, Series B, p. 127, 1916.

[9] *Annals of Botany*, Vol. XXIX., p. 223, 1915.

[10] *Trans. Instit. Mining Engineers*, Vol. LIV., Pt. II., p. 33, 1917.

[11] *Jour. Linn. Soc.*, Vol. XLIV., p. 59, 1917.

[12] *Annals of Botany*, Vol. XXXII., p. 437, 1918.

[13] *Ibid.*, Vol. XXIX., p. 531, 1915.

as habitat-forms of one species, the differences in structure being attributed to the influence of water. In this as in many other recently published papers it is satisfactory to find that authors are now paying more attention than formerly to the significance of structural features as indices of climate and habitat. Mr. Sahni's critical morphological study of the branching of the leaf-trace in certain Carboniferous genera of ferns[14] throws light on some previously misunderstood anatomical features and illustrates the value of the application of broad philosophical generalizations based on intensive study of allied forms. Miss Holden's account of the anatomy of two Paleozoic Cardaitalean stems from India;[15] placed in the genus *Dadoxylon*, supply welcome information on the structure of plants belonging to the *Glossopteris* flora: the occurrence of well marked rings of growth in the wood of both species is a fact of special interest from the point of view of the climatic conditions under which the plants of the southern flora flourished. A report of a British Association Committee published in 1917 summarizes opinions on the vexed question of the classification[16] of the older rocks of Gondwana land in which plants of the *Glossopteris* flora are preserved.

Researches of both scientific and economic interest into the composition and mode of origin of coal have in recent years attracted the attention of several workers. The most important piece of work of this kind is that by Dr. Stopes and Dr. Wheeler,[17] a happy combination of expert botanical and chemical knowledge. The authors begin by defining ordinary coal as a "compact, stratified mass of mummified plants free from all save a very low percentage of other matter," that is practically a deposit of plants alone. It is rightly claimed that too little attention has hitherto been paid to research following logical deductions from our knowledge of the chemical composition of plants. The authors deal with modes of accumulation of coal-forming vegetable material action of the solvents on coal, the effect of heat, distillation at different temperatures, microscopic evidence bearing on the constitution of coal derived both from the coal itself and from the petrified tissues preserved in the calcareous nodules of certain coal seams. A very useful bibliography is appended. Mr. Lomax[18] has continued his microscopical analysis of coal seams and discusses the part played by different plants and parts of plants in the composition of coal. Similarly Mr. Hickling,[19] who writes on the micropetrology of coal, reviews previous work and gives the results of original observations; he attributes differences in coal rather to the result of varying degrees or varying modes of alteration than to differences in the nature of the original constituents.

3. *Mesozoic Plants.*—Dr. Arber's memoir, published shortly before his death, on the older Mesozoic floras of New Zealand,[20] is a particularly welcome contribution to our knowledge of the little known botanical history of that country. He deals with Triassic-Rhætic, Jurassic and Cretaceous plants. The author shows that no Palæozoic flora has so far been discovered: the absence of any undoubted examples of the common southern hemisphere genus *Glossopteris* leads him to express the view that New Zealand did not form part of that extensive continent known as Gondwana land in the Permo-Carboniferous period. An account is given of a remarkable petrified forest at Waikawa, Southland, consisting chiefly of some conifers and well-preserved osmundaceous stems. Dr. Arber's work clears up many obscure points and corrects erroneous statements by previous authors.

Important contributions have been made to our knowledge of Jurassic plants, notably the description of a new genus, *Williamsoniella*,

14 *Ibid.*, Vol. XXXII., p. 369, 1918.

15 *Annals of Botany*, Vol. XXXI., p. 315, 1917.

16 British Assoc. Report, 1917, p. 106.

17 Monograph on the Constitution of Coal. Dpt. Scientific and Industrial Research, London, 1918.

18 *Trans. Instit. Mining Engineers*, Vol. L., Pt. I., p. 127, 1915.

19 *Ibid.*, Vol. LIII., Pt. III., p. 137, 1917.

20 New Zealand Geol. Survey, Paleontological Bulletin No. 6, Wellington, 1917.

of Cycadophyta by Mr. Hamshaw Thomas[21] (now Captain Thomas) founded on material collected by him at Gristhorpe bay on the Yorkshire coast. This genus possessed fertile shoots bearing small ovules and interseminal scales crowded on a pyriform axis and surrounded at the base by a whorl of microsporophylls each bearing 5–6 synangia. The bisexual shoots were almost certainly borne in the forks of a slender dichotomously branched stem like that of *Wielandiella,* and there are good grounds for regarding the supposed fern leaves known as *Tacniopteris vittata* as the foliage of this Bennettitalean plant. Mr. Thomas's discovery[22] of a bed of mummified plant remains in the Lower Estuarine series at Roseberry Topping, Yorkshire, enabled him to investigate minutely the epidermal characters of the problematical genus *Thinnfeldia;* he believes that the fragments of leaves and twigs of which the deposit is mainly composed were borne on trees, an interesting suggestion at variance with previous views on the nature of the genus. This author also describes a Yorkshire specimen of *Williamsonia*[23] in the Paris Museum which is probably the male flower of *Williamsonia gigas.*

Miss Holden's account of a new type of coniferous stem, *Metacedroxylon*[24] from the Corallian of Sutherland, Scotland, adds another to an already long list of Mesozoic types exhibiting a mixture of Abietineous anatomical characters. An examination by the same author[25] of impressions of Wealden fronds previously referred to the genus *Cycadites* and believed to be closely allied to the recent *Cycas* shows that they should be transferred to *Pseudocycas.* A paper by Mr. Clement Reid and Mr. Grove[26] on Characeæ from the Purbeck of Dorset gives a preliminary account of their researches into the fossil representatives of this neglected family; they describe a new genus, *Clavator,* characterized by club-like nodes on the stem and by other characters. Dr. Marie Stopes has instituted a new genus, *Planoxylon,*[27] for a Cretaceous New Zealand coniferous stem combining Abietineous and Araucarian features; she suggests that this generalized type points to the existence in the southern hemisphere of an extinct group of conifers of unexpectedly Abietineous affinities. The same author[28] describes the structure of the first specimens of roots of *Bennettites* so far discovered.

Several papers by Dr. Ellis[29] deal with fossil fungi and include descriptions based on characters of doubtful value of some supposed new species from Jurassic and Cretaceous rocks; the author also discusses the rôle of microorganisms in the formation of ironstones.

4. *Tertiary and Pleistocene Plants.*—Mr. Dutt's careful account of *Pityostrobus macrocephalus,*[30] believed to be allied to *Pinus excelsa,* from the Lower Eocene of the London Basin is an interesting morphological contribution and reveals the occurrence of unusual features in this well-preserved Abietineous cone which have been overlooked by previous authors. Papers by Mr. Clement Reid[31] and by Professor Marr and Miss Gardner[32] extend our knowledge of the Arctic Pleistocene flora of England and of the conditions under which the plants grew.

In his "Notes on *Calamopitys*"[33] Dr. Scott deals with the same fulness and critical insight with the known species of this Lower Carboniferous genus, a type showing certain affinities to *Lyginopteris* and *Heterangium.* We have unfortunately no knowledge of its reproductive organs. The paper contains

21 *Phil. Trans. R. Soc.,* Vol. 207, Series B, p. 113, 1915.

22 *The Naturalist,* January 1, 1915, p. 7.

23 *Proc. Cambridge Phil. Soc.,* Vol. XVIII., Pt. III., p. 105, 1915.

24 *New Phytologist,* Vol. XIV., p. 205, 1915.

25 *Ibid.,* Vol. XIII., p. 334, 1914.

26 *Proc. R. Soc.,* Series B, Vol. 89, p. 252, 1916.

27 *Annals of Botany,* Vol. XXX., p. 111, 1916.

28 *Ibid.,* Vol. XXXI., p. 257, 1917.

29 *Proc. R. Soc. Edinburgh,* Vol. XXXV., Pt. I., p. 110, 1915; *Knowledge,* Vol. XXXIX., p. 73, 1916; *Geol. Mag.,* Vol. IV., p. 102, 1917.

30 *Annals of Botany,* Vol. XXX., p. 529, 1916.

31 *Quar. Jour. Geol. Soc.,* Vol. LXXI., p. 155, 1917.

32 *Geol. Mag.,* Vol. III., p. 339, 1916.

33 *Jour. Linn. Soc.,* Vol. XLIV., p. 205, 1918.

much that is new and is a valuable contribution to the difficult subject of the interrelationship of several Palæozoic plants exhibiting remarkable complex anatomical features.

A. C. Seward

University of Cambridge

SPECIAL ARTICLES

THE BLACK CHAFF OF WHEAT

The continued prevalence of black chaff of wheat in the United States makes it desirable to have a Latin-scientific name for the bacterial organism causing it. This organism resembles *Bacterium translucens* (see *Journal of Agricultural Research,* Vol. XI., p. 625, 1917), cause of the bacterial blight of barley. In cross inoculations on the leaves of seedling plants the barley organism on wheat has proved either non-infectious or has produced small non-typical lesions. On the other hand, inoculation experiments have shown that the wheat organism is practically as pathogenic on barley as it is on wheat and the lesions so produced on barley are indistinguishable from those produced by the barley organism itself. There also appear to be minor cultural differences. It is suggested, therefore, that for the present, at least, the wheat organism be distinguished as *Bacterium translucens* var. undulosum with, in general, the characteristics already given for the species:

Var. undulosum nov. var., cause of the black chaff disease of wheat, produces yellow or translucent stripes on leaves, water-soaked or black stripes on culms, and longitudinal, more or less sunken, dark stripes or spots on the glumes. In moist weather the bacteria often ooze to the surface of the diseased spots or stripes as tiny beads or drops, drying yellowish. From sections of diseased leaves or glumes mounted in water they ooze in enormous numbers (like smoke out of a chimney) making the fluid cloudy. This organism attacks also the kernels, especially at the base causing them to be shrunken and honeycombed with bacterial pockets, but even when the kernels are not attacked their surface is liable to be infected from the diseased glumes. When the disease appears early and is severe the heads are dwarfed. Surface colonies on thin-sown agar plates are circular, pale yellow, smooth (like polished glass) and structureless on the surface, usually homogeneous also by direct transmitted light, but by oblique transmitted light (half-light) the interior is seen to be full of minute waves or interblending striations which persist, and which are best seen with a hand lens. It can be distinguished easily and quickly from accompanying non-parasitic yellow forms by this character alone. Slime copious and very pale yellow on potato agar; on whey agar very copious and bright chrome yellow—slime on this medium deeper yellow and less fluid than that of the barley organism.

Infections have been obtained repeatedly on wheat leaves and glumes. The disease is transmitted to young seedlings by way of the wheat kernels. It occurs in all the wheat states of the Middle West.

For earlier notes consult Science, N. S., Vol. XLIV., No. 1134, p. 432, 1916, the *Journal of Agricultural Research,* Vol. X., No. 1, 1917, and the *Plant Disease Bulletin* (issued by The Plant Disease Survey, Bureau of Plant Industry, U. S. Department of Agriculture), Vol. I., No. 2, 1917, and Vol. II., No. 6, 1918.

Erwin F. Smith,
L. R. Jones,
C. S. Reddy

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY. V

The rapid determination of titanium in titaniferous iron ores: John Waddell. The ore is fused in a silver, copper or iron crucible with sodium peroxide, for about ten minutes. The crucible with the fused mass is brought into a beaker with water, and the disintegrated material dissolved in sulphuric acid. Tartaric acid is added to keep the titanium in solution. Sulphuretted hydrogen is passed through the solution. If a copper or silver crucible has been used, the precipitated sulphide is filtered off, and to the filtrate, ammonia is added and more sulphuretted hydrogen is passed. To the filtrate from the iron sulphide, sulphuric acid is added and the solution is boiled to drive off the

sulphuretted hydrogen and to coagulate the sulphur. After filtration, the solution can be made up to a given volume, and an aliquot portion taken for comparison of the color produced by addition of hydrogen peroxide, with that of a standard titanium solution. Or, the titanium may be precipitated with cupferron, and the precipitate burned and weighed as titanium oxide. A standard magnetite of the Bureau of Standards containing 0.99 per cent. TiO_2 was analyzed, and the results were within a few hundredths of a per cent. of that given. Concordant results were also obtained with an ore containing between thirteen and fourteen per cent. of TiO_2. Fusion of the ore with borax in a platinum crucible also gave satisfactory results, the disintegration of the fused mass being however not so rapid as when sodium peroxide was used.

The calculation of the efficiency of the silent discharge process for nitrogen fixation: F. O. ANDEREGG. Oxygen combines with nitrogen in the silent discharge. The discharge evidently changes the comparatively inert molecule into a more active condition which is probably atomic. The energy required for this activation is all that is necessary for the fixation of nitrogen. The splitting up of the molecules is probably the result of electrons, which have acquired a suitable velocity by falling through a minimum potential gradient colliding with the oxygen or nitrogen molecules. To calculate this energy of activation of oxygen use may be made of the fact that ultra-violet light of a wave-length shorter than 190 $\mu\mu$ is completely absorbed by oxygen with ozone being formed. This corresponds to a potential gradient of about 6.4 volts using the quantum theory. Then to activate one mol of oxygen requires about 146 large calories. For nitrogen the wave-lengths have not been similarly determined but the recent work of Davis and Goucher[1] makes the value of 9 volts seem to be a likely one. This corresponds to 207 calories per mol. At ordinary temperatures in the silent discharge the nitric oxide first formed is oxidized not merely to tetroxide but, because of the excess of ozone, to pentoxide, requiring one more active oxygen for this step. The complete reaction for the formation of nitric acid anhydride is then

$$2N(-207) + 2O(-146) + O_2 + O(-73) = N_2O_5(+1.4) + 427.4 \text{ calories.}$$

The numbers in brackets represent the values in large calories required for the formation of the substance from the ordinary molecular condition of the elements. On an efficiency basis this amounts to about 250 grams of nitric acid per kilowatt hour. This possible yield compares favorably with the 134 grams obtainable from the union of oxygen and nitrogen at 4,200° A. in the purely thermal process. In practise a combination of the thermal and electrical process is used. Similarly in the formation of ozone the limiting yield is about 510 grams per kilowatt hour as compared with 80–90 grams, the best results actually obtained with an efficiency of 15–17 per cent.

The viscosity of casein solution—I., the effect of P_H: HARPER F. ZOLLER. The study of the viscosity of casein in alkaline solutions was taken up with the ultimate object of determining its chance relationship to the adhesiveness of such solutions. Viscosity curves of Hammarsten and Dairy Division caseins dissolved in sodium hydroxide show a maximum viscosity in the region of 9.0 P_H. The slope of the curve is very precipitous on either side of the maximum. The hydrogen-ion concentration was measured both colorimetrically and electrometrically; the Clark electrode-vessel being employed for the latter determinations. A great significance is attached to the flattening of the viscosity curves immediately following the decline from the maximum. This is intimately correlated with the alkaline hydrolysis and evolution of ammonia in this zone. Solutions of casein in ammonia do not exhibit the precipitous decline from the maximum viscosity, although the maximum is in the same narrow region of P_H. The observations of Sakur, Pauli, Chick and Martin and Robertson were reviewed.

Periodic vibrations in gels: J. M. JOHLIN.

Boiling point of liquids: F. P. SOEBEL. Basing his deductions on the assumption that at the boiling point of a liquid the vibratory energy of individual molecular constituents of the liquid and of its vapor must be equal, the author finds that the absolute temperature T_x of the boiling point of an absolutely pure liquid is expressible as

$$T_x = \frac{mp_xvx}{1.49}$$

in which formula m represents the molecular weight of the substance or compound and p_x and v_x the pressure and volume of the vapor at the temperature T_x. For ordinary liquids containing impurities lowering the boiling point, the above equation reads,

$$T_x = \frac{(p_xv_x - C)m}{2}$$

[1] *Phys. Rev.*, 13, 1–5, 1919.

C being a constant, individual for each liquid; being taken at 8.7 for water and m at 18 the last equation yields

$$T_x = \frac{m}{1.49}(p_x v_x - 8.7) = 12.1(p_x v_x - 8.7).$$

Since we calculate from tables of properties of saturated vapor of water that *pvat* 273° absolute amounts to 31 calories per kilogram the above equation for T_x gives

$$12.1\ (31\text{–}8.7) = 270° \text{ absolute}$$

at 313 degrees at which pv is 34.6 cals. we find

$$12.1\ (34.6\text{–}8.7) = 313.3° \text{ absolute.}$$

At 473 degrees absolute pv is equal 47.9 calories and

$$12.1\ (47.9\text{–}8.7) = 473.5° \text{ absolute.}$$

Similar agreement is found for other vapors by inserting the correct valve for constant as long as no psolymerisation in the liquid takes place.

(1) *Molecular state of water vapor;* (2) *Vapor pressure depression equation for dilute aqueous solutions:* JAMES KENDALL.

Size and behavior of suspended smoke particles: R. E. WILSON.

Influence exerted by antagonistic electrolytes on the electrical resistance and permeability of emulsin membranes: G. H. A. CLOWES.

The exact determination of molecular weights by the boiling point method: E. M. WASHBURN.

Solubility of strontium nitrate in anhydrous alcohol in alcohol containing small per cent. of water: C. W. FOULK.

(1) *Influence of the age of ferric arsenate on its peptisation;* (2) *Syneresis of silicic acids gels:* H. N. HOLMES.

A study of the lowering of vapor pressure of water produced by absorbed KCl: B. F. LOVELACE, J. C. W. FRAZER, V. B. SEASE.

A study of the lowering of vapor pressure of water produced by absorbed mannite: J. C. W. FRASER, B. F. LOVELACE, T. H. ROGERS.

The volume and surface of the pores in charcoal and the compression of adsorbed substances: W. D. HARKINS and D. T. EWING.

An electromagnetic and valence hypothesis of heterogeneous equilibrium in adsorption: W. D. HARKINS.

DIVISION OF WATER, SEWERAGE AND SANITATION

Robert Spurr Weston, *Chairman*

W. W. Skinner, *Secretary*

Determination of bromid in mineral waters and brines: W. W. SKINNER and W. F. BAUGHMAN. Colorimetric methods for the determination of bromin give satisfactory results only when small quantities of bromin are to be determined. The method proposed for the determination of bromids in the presence of chlorids is the oxidation of the bromids and removal of the liberated bromid by steam distillation or by aspiration. The method depends upon the use of chromic acid for oxidation of the bromid. Chromic acid in concentrated solution liberates bromin from bromids quantitatively at room temperature and the bromin may be removed by aspiration. It liberates only a trace of chlorin from chlorids, forming probably chromic chlorid which remains in solution. When chromic acid acts on a solution of chlorids and bromids, some chlor-bromid is formed which is removed with the bromin by aspiration. The liberated bromin and the chlorin in the first aspiration is collected in a solution of sodium sulphite and sodium carbonate, which is evaporated to dryness and again submitted to the treatment with chromic acid and aspirated the second time. The double aspiration gives very accurate results.

Certain war gases and health: CHARLES BASKERVILLE. Evidence has been collected from all the chlorine producing plants and many works and arsenals where chlorine was used. Preponderating evidence favors the conclusion that chlorine exerts a preventative influence against influenza. The evidence is not conclusive, however, as contrary data were obtained from some plants. The contradictions may possibly be harmonized on the basis of concentration, the more dilute up to limits the more effective. Small amounts of bromine in the air appear to prevent influenza completely.

CHARLES L. PARSONS,
Secretary

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CONTENTS

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DEMOCRATIC COORDINATION OF SCIENTIFIC EFFORTS[1]

COOPERATION and coordination are the very essence of all evolution and progress, biological, social, political, moral, industrial or what not. We acknowledge without controversy the fundamental rôle of these factors in the evolution of living things. They constitute the woof and warp of the social fabric, without them political machinery can not function, and the wheels of industry cease to turn; they condition every ethical and moral principle. It is the glory of science that it has uncovered and made clear this fundamental fact of organic evolution. But in the organization of its own activities how little has it profited by its own discovery. The Honorable Elihu Root has well said:[2]

> Science, like charity, should begin at home, and has done so very imperfectly. Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the difference from the past seem to be of kind rather than of degree. It has organized itself very imperfectly. Scientific men are only recently realizing that the principles which apply to success on a large scale in transportation and manufacture and general staff work apply to them; that the difference between a mob and an army does not depend upon occupation or purpose but upon human nature; that the effective power of a great number of scientific men may be increased by organization just as the effective power of a great number of laborers may be increased by military discipline.

It may well seem strange to the layman that

[1] Presented in the symposium on "Our present duty as botanists" before the joint session of the Botanical Society of America and the American Phytopathological Society, December 26, 1918, at Baltimore, Md.

[2] SCIENCE, N. S., 48, 532–534, 1918.

scientists have not applied to their own profession the doctrine of cooperation and coordination so vigorously and successfully preached to others. Yet the fact remains that while the rest of mankind has gone far along the way which we have discovered and pointed out we still remain largely isolated and intrenched in the feudal towers of our individualism. Here behind moat and wall we shape and fashion those intellectual darts with which at our annual tourneys we hope to pierce the haughty pride of some brother baron. Yet common sense, the common-good, the very progress of our profession demands that we abandon this ancient outworn attitude.

For more than four years now we have been witnessing one of the greatest convulsions in the inexorable march of human evolution. Again the intrenched autocracy of individualism has gone down before the invincible march of democratic socialism and we look with longing expectation for the consummation of that age old dream, a true league of mankind, free from the blighting menace of individual selfishness.

How then shall scientific men, who often and in so many ways have pointed out the path along which mankind shall realize its vision of common brotherhood, perfect in their own relations the doctrine which they have so persistently and effectively taught. How shall we truly cooperate and effectively coordinate our efforts and discoveries. While I must admit the obstacles and the difficulties which confront us, frankly I see none that are fundamental or insurmountable. They are in nowise of a different sort or more formidable than those which confront other men. Every honest scientist must admit the desirability, yes the very necessity of scientific cooperation, if we are to maintain that lofty position of disinterested leadership in the economic affair of mankind which we so long have held to be our natural heritage.

But one short year ago this body of men acknowledged this grave necessity by their common effort to organize themselves for more effective participation in the gigantic struggle then at its zenith.

What then are some of the specific difficulties with which we are confronted. One says, "This is my idea, how shall I be protected in my possession and exploitation of it" and he hoists aloft the bugbear of priority, at once the reward and the curse of scientific work. "What," cries another, "shall I share my immature conclusions with my intellectual inferiors," and then proceeds to contribute another half-baked fragment to the crumbs that litter scientific publication. Is any truly scientific man so poor in ideas that he can not afford, forsooth, the loss of a crumb or two if that the common good be better served by the free and open display of his wares? I have been ever free to expose my own discoveries and ideas on scientific matters for the consideration and criticism of my colleagues nor am I aware that any of them has ever been intentionally filched or appropriated. It may well be of course that all of them have been like the contents of the proverbial purse. No man shall thus greatly lose, for by the very display itself he most protects that which is truly his; for who will steal cakes from the common table and hope to get away with it? Another invokes the shades of a jealous director to justify his selfish doubts of the possibility of cooperative action. Well, have we not ever boasted of our academic freedom, and if we choose to pool our ideas shall autocratic administrators rise to say us nay? Real administrators most recognize the value and advantages of cooperation and will be the first to approve our efforts in this direction. The common good alone deserves consideration. Will any one gainsay the fact that more than half the words with which we dress our darlings for the press are so much padding old and soiled with wear? How immature and verdant too, too many of them are. Then why not bring them forth in all their nakedness and let the eyes of all the tribe appraise them at their worth, discuss them, test them, fit them in their proper place and stamp with general approval that which posterity may use with confidence and gratitude. Think of the weary hours we now must give to burrowing in literature. Then shall we not forswear our

selfishness and join to make an end of a condition unscientific and unsound?

"It can't be done!" It has been done, is being done to some degree right now among us. And you will pardon me, I trust, if I bring forward in proof of this assertion a piece of cooperative research in my own field. Under the auspices of the War Emergency Board of American Plant Pathologists, workers in fifteen states and in the federal department have planned and carried out cooperatively a most extensive investigation on cereal seed treatment with the result that in one year we have approached general agreement upon a single simple safe and most effective method, of wide application, for the control of externally-borne, seed infesting cereal smuts. I need not dwell upon the advantages thereby accruing to science and to practical agriculture.

Once more I beg your indulgence. In a single conference of two days duration the potato disease pathologists of the continent in August, 1918, in free and open exchange of facts and ideas made more progress toward the solution of the difficult problems of leaf roll and mosaic, than would have been accomplished in five years of individual reflection in solitary confinement.

It is evident, of course, that cooperation and coordination of our scientific activities can not be accomplished without organization. The character of this organization is a most vital consideration. It can not be imposed upon us, it must be of our own making. It must be truly democratic and without autocratic possibilities. Moreover, it must directly affect only those individuals who of their own free choice are willing to associate themselves together to this end, nor shall any one be excluded who is prepared to enter this association with zeal and unselfish purpose. But organization alone, no matter how democratic, can not succeed without good leadership; leadership of the highest order, strong, vigorous, of broad vision, wholly devoted to the common good, above reproach. We must demand that the ablest shall lead and we must give them our fullest confidence, our heartiest allegiance and our unqualified support in the undertakings.

Having now set forth what I believe to be the most fundamental factors for success in cooperative undertakings in scientific work, I may be expected to present something concrete respecting the *modus operandi* by which we may hope to realize this success. In presenting for your consideration the following plan I am not without experimental data upon which to base my opinion that it will be found exceedingly workable. It is essentially the method by which the American plant pathologists have, during the past year, sought to speed up accomplishment within their own field. The results have been so remarkable, so indicative of what cooperative effort may be expected to accomplish, and the methods by which this has been effected, so generally approved amongst us, that I venture to predict that the machinery which we have evolved will, in its essentials, best serve to promote in other fields of science the true spirit of cooperation and coordination. The thing about which all cooperative effort in science must center is the solution of some definite problem, be it one of research, of teaching or of extension. For the solution of this problem a number of workers voluntarily agree to associate themselves. The ideal condition is that in which all workers in any way interested in the problem become co-partners in the attack upon it. Not only that but there must be a general understanding that any person who in the future becomes interested may, without hesitation, claim the privilege of associating himself in the undertaking. In short those uniting for the conduct of a given project, constitute the *project committee*. Each project committee selects from among their number some one to be their leader, note I say leader, for only under real leadership can the work be carried to a successful consummation. If the committee finds that it has been mistaken in its choice the evident and democratic expectation is that it will promptly choose another to lead. Just what is expected of the committee chief is clearly implied in the word *leader* and I therefore need not dwell upon

his qualifications or his duties. It should be clear, however, that neither planning of the project, nor partitioning of the field nor assignment of work is to be a function of the leader or of any group within or without the committee. Each individual must be free to undertake that which his inclination and his facilities dictate. Nor shall any one reserve to himself alone any phase of the problem whatsoever. Each must feel free to duplicate, to test or to try the work of the other. The solution of the problem is the thing and personal aggrandizement at the expense of one's colleagues must give place to personal service and its more lasting rewards, for I am convinced that there will be more of glory and renown for each participant in a cooperative accomplishment, complete and well rounded, than in the best fragment which any of them alone might pass down to posterity.

You will next demand to know how effective cooperation and coordination within the committee is to be assured without personal contact and exchange of view. I reply, it is not. This brings us to a consideration of the *project conference*. A conference of at least a considerable majority of those proposing to associate themselves together in the work will be requisite for the very organization thereof; and the selection of a leader will be by no means the only business. At the initial conference there must be the freest and fullest exchange of data already in the hands of each member, of all the ideas, yea, of all the "hunches" which each may have upon the subject. Every man's cards, all of them, must be upon the table, faces up. They must in the very beginning pool, in the fullest sense of that word, their combined resources and then there must be an exhaustive examination and discussion of every item presented, with finally a summarized inventory of their stock in hand. With this before them, plans for future work will be agreed upon and each will return to his post to carry forward to the best of his ability that portion of the work which he himself has chosen to do, feeling that he has a vital part in a vital problem worthy of his best endeavors. Nor will he be tempted to dissipate his time and energy on other phases of the problem which he feels are necessary compliments to that upon which he desires to concentrate his efforts. He will know that another seeks their solution and will bring them eventually for fitting together with the parts which he himself has shaped.

Succeeding conferences on the project must be arranged. They should at least be annual for while much may be accomplished by correspondence it is only in the heat of personal discussion that the various parts can be effectively welded into a coordinate whole.

There is much virtue in conferences of real cooperators. They are not the "talk-fests" and sparring matches of competing individualists. They are the business meetings of an open corporation. They are not for the reading of preliminary papers, they are for the making of comprehensive contributions. They require days not hours. Two solid days including the intervening evening were required to organize the project work on potato mosaic, leaf roll and seed certification in the Buffalo conference of potato disease pathologists last August; and no time was wasted. These conferences must be arranged for and the cooperators must be gotten to them. The necessary traveling funds must be found.

And now I hear some skeptic mutter to his neighbor, "But how about publication." The answer is simple. A group of men who will cooperate in the solution of a scientific problem will also cooperate in the publication of their work. That too is their problem, and different groups will solve it differently.

It is apparent that some organization or association of the units, the project committees, is not only desirable but perhaps imperative. They need the stimulus that comes through association; each needs to coordinate its own problem with the related ones. This has been accomplished to some extent by the phytopathologists in the formation of general project committees consisting of the leaders of the committees on closely related projects, as for example the general potato disease project committee, of which Dr. W. A. Orton is now leader.

Within each well-defined field of science, where cooperative projects of the kind I have indicated are in operation, there should be and naturally would be provided a general coordinating board of strong, aggressive but tactful leaders, small in numbers, but alert and far seeing, who would guide, not direct, the effective organization and development of the cooperative idea.

Such a board must be constituted through the free and well considered choice of a democratic electorate. I believe that the plan which will insure most satisfactory and effective results is the selection of a leader by vote of all the cooperating workers in the field. The leader to select, subject to their approval the remaining members of the board. The size of the board, tenure of office and other details of a like nature are of relatively little importance so long as they remain subject to the control of a live democracy.

To hold that such a program as I have here outlined can be carried through easily and without difficulties would be to acknowledge ignorance of human nature. The selfishness of individuals has always been the chief obstacle to cooperative undertakings and selfish ambition is not uncommon among scientific men. Yet the measure of the success of true democracy will always be the extent to which this human weakness is suppressed and eliminated. Cooperation among scientists for the solution of problems must come. In no other way shall we be able to rise to the demands and the opportunities of the age. The pioneer days of science are largely over and progress is to be made only by organized and united effort. Why shall not the botanists of America lead? Already one group among us has indicated the possibilities in this direction. Botany in its broadest sense must justify itself in an economic world even as chemistry is doing and there is no want for opportunities. Colleagues shall we organize, shall we cooperate, shall we coordinate, and shall we show the way?

H. H. WHETZEL

CHAIRMAN OF THE WAR EMERGENCY BOARD
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ON DUTY-FREE IMPORTATION

BEFORE the great war, the practise of importing duty free many things required by educational institutions had become so thoroughly established as to be regarded as part of the normal course of events. What had first been regarded as a special privilege came to be looked upon as a special right; and institutions, justly or unjustly, considered themselves entitled to purchase anything required for their maintenance in the lowest world market and to do this quite regardless of any conditions of high tariff or low tariff. Prohibitive tariff; protective tariff; tariff for revenue only had little or no interest for them. "Made in Germany," "Made in Japan," "Made in England," were more familiar inscriptions on laboratory apparatus than "Made in America."

In August, 1914, duty-free importation was stopped and now for the first time it is possible to resume it again. The question of whether or not it is desirable to do so is to the mind of the writer a pertinent one.

That it was the part of wisdom and good policy in the early days of our country when "higher education" was represented by a few denominational institutions, mainly supported by private contributions to grant them the privilege of importing without duty the instruments necessary for their research, is beyond question.

Science was practically unknown in this country; in fact, science as we know it to-day was almost unknown in the world. The amount of apparatus required by all the world was but a small fraction of that now utilized by America alone. An astronomical telescope, a compound microscope, a spectroscope was a rare instrument for which the world must be sought over, and having located an instrument of scientific interest, what more natural than that the pioneers of science in this country should be allowed to import it duty free? They were furthering the development of science and education and helping to create the demand that now exists for enormous quantities of such instruments, many of which have developed entirely out of the class of scientific

curiosities and experimental instruments and become everyday tools of trades and professions.

That it was the intention of the legislators to accomplish this very end is evident from the wording of the act granting the privilege. In enumerating the list of free goods it includes: (A) "Books, maps, music, engravings . . . publications (not including advertisements) for gratuitous circulation." (B) "Publications, *not more than two in any one invoice* in good faith for the use of any society or institution, incorporated solely for religious, philosophical, educational, scientific or literary purposes." (C) "Philosophical and scientific apparatus, utensils, instruments and preparations including boxes and bottles containing the same in good faith for the use and by the order of any society or institution" as above described "and not for sale."

These three provisions are incorporated in the same act and referred to in the same paragraph in 1918 annotated edition of Federal Laws. Does it not appear reasonable that if the original framers of these laws could have looked far enough into the future to see the enormous number of identical instruments now imported by single institutions for use in student laboratories, and thus virtually sold to the students in their payment of tuition and rents, even though the institution may retain its title to them till they are worn out, that they might have added the same provision in regard to instruments that was set down concerning books of learning, viz: "not more than two in any one invoice"?

It is of interest too to note the trend of opinion as to what was intended to be granted by this provision and what constitutes "philosophical instruments" by noting the interpretations that have been put on the question by the courts.

In 1890, one Oelschlaeger imported a consignment of mixed goods, all of which he claimed were to be classified as "philosophical instruments" and entitled to the special provisions and exemption due to goods so classified. Robertson, an official whose duty involved the appraising of goods and classifying them for rates of duty, declined to accept this classification and demanded the duty on them when classified as "mechanical instruments." Oelschlaeger brought suit for the recovery of duty so paid. The court found for the defendant in a portion of the goods and for the plaintiff in another portion. In handing down the decision, the following language was used:

> The most that can be done, therefore, is to distinguish between those implements that are used more especially in making observations, experiments and discoveries and those which are more especially used in the arts and professions. For example; an Astronomical Telescope, a Compound Microscope, a Ruhmkorf coil, would be readily classified as philosophical instruments or apparatus. While the instruments commonly used by surgeons, physicians and navigators for the purpose of carrying on their several professions and calling would be classified amongst mechanical implements, or instruments for practical use in the arts and professions. . . .

Continuing the quotation:

> It is somewhat difficult [said the Court] in practise to draw a line of distinction between the two classes in as much as many instruments originally used for the purpose of observation and experiment have since come to be used partially or wholly as implements in the arts.

Among the goods included in this particular consignment were a high-grade compound microscope, a small and simpler microscope for the examination of textiles and an ophthalmoscope. The former of these three instruments were held to be philosophical instruments, while the two latter were not deemed entitled to this classification.

In a similar case in 1885 in Manassee *vs.* Spalding, it was held that anemometers, hygrometers, Ruhmkorf coils, galvanometers, Geissler tubes, Granet batteries and radiometers were "philosophical apparatus," but that surveyors' compasses could not be so classified.

We fail to find any recent court decision in regard to the separation of instruments into philosophical apparatus and the implements required for pursuing a given trade or profession, but viewed in the light of the case just cited it seems to us not improbable that if the court were called on now to render a

decision distinguishing philosophical instruments from working tools, that many instruments now classed as "philosophical" would be found to have progressed into the class of instruments for practical use.

It is reasonable to consider not only the intention of the law originally passed and its subsequent interpretation by the courts, but to ask ourselves the question, what policy at the present time is just and what would most tend to the development of scientific research? Let us grant, if you wish, that educational institutions whether private, semi-private, as those partially supported by private contributions, and partially by taxation, or entirely public as our great state universities, are entitled to subsidy from the federal government. Is such subsidy best granted by exempting them from paying duty on certain classes of goods and not on others?

Let us consider for example a great university in process of building. For its halls it will require a large amount of window glass; for its chemical laboratories it will require glass beakers, flasks, etc. Both are essential, both are made in America and both are protected by duty, but the university enjoys especial exemption from paying duty on one and not the other.

We deem it not just to thus discriminate against the manufacture of the glass that happens to be used for scientific purposes.

Not justice alone, but also expediency must be considered in determining a national policy, for manifestly the apparent rights of one individual or firm should not be allowed to prevail in opposition to the general good. We, therefore, consider lastly the question, Is it expedient in case of tariff resumption to exempt schools and colleges?

Education in this country is no longer an "infant industry." There were listed in Patterson's Educational Directory for 1916 approximately 700 colleges and universities, embracing 144 technical schools, 31 schools of mines, 137 schools of agriculture, 20 schools of forestry, 128 schools of medicine, 60 schools of dentistry, 31 schools of metallurgy, 91 schools of pharmacy and 27 schools of veterinary medicine. These do not include normal schools and "teachers' colleges" of which there are about 450, to say nothing of the enormous number of public and private secondary schools, schools of domestic science and others requiring varying amounts of "scientific and philosophical" apparatus. Who can estimate the extent of the requirements of these institutions for apparatus and materials more or less properly classified as "scientific"? They are certainly of sufficient magnitude to be worthy of the best brains and best energy America can produce. By the policy of duty-free importation such brains and such energy will be diverted to channels yielding greater immediate financial returns.

Furthermore, research and investigation, while interesting, to be of benefit to humanity must be developed to practical ends. The application of scientific research to all the arts and industries was never so prevalent or necessary as at the present time. Scientific apparatus is now as necessary to the development of many of our important industries as to the training of men to do the work. These industries constitute a further demand for scientific and technical instruments that is sufficient to aid greatly in supporting American manufacturers of such goods, and we believe that in the long run the cause of education can best be served by permitting educational institutions to aid in the developing of these industries under a policy of protection commensurate with that accorded the production of other necessities for the comfort, prosperity and progress of the great mass of American people.

It is true that at the present time certain instruments, notable among which are spectrometers, polarimeters, refractometers, etc., necessary or desirable for the advancement of science, are not manufactured in this country, and it is also true that under present industrial conditions their manufacture can not be begun in competition with European instruments imported duty free; but we believe, furthermore, that it is true that their manufacture once begun American competition would develop American efficiency, and that in a short time our institutions would be better served by Americans than they have been in the past by Europeans.

It appears to us that the duty-free privilege has, in a measure at least, defeated its own end in depriving the American manufacturer of means necessary to put the time, thought and experiment into high-grade scientific instruments which is requisite for real progress, leaving us dependent on foreigners for such investigations and the advancement incident thereto. If a few have apparently been able to make a notable exception of their products, this has been accomplished only by placing on a purely commercial basis an industry which ought to be, in fact, must be, for long-continued success based on the firm foundation of scientific research. The impossibility of properly conducting such research has often reduced us to the status of imitators dependent for our own progress upon investigations conducted on the other side of the ocean.

If it has been imposible, under existing conditions, to manufacture or properly develop instruments already known, what can be expected in the way of new instruments to accomplish new purposes. Increasing and expanding research calls for new and modified instruments and, *vice versa*, new instruments uncover new lines of research. In other words, the two go hand in hand. The retarding of one retards the other, and the stimulation of one stimulates and helps the other.

What is true in regard to science in the abstract is equally true in regard to men doing scientific work. The development of the manufacture of scientific instruments under a protective policy will thus react favorably on the educational institutions themselves by building up a demand for their graduates. It is manifestly absurd to endeavor to discriminate between a policy beneficial to educational institutions and one desirable for the people as a whole. Our educational system from the kindergarten to the university is our very life blood; we can not promote the institution to the detriment of the people, nor can we favor other interests at the expense of the institution.

The great bulk of education in our country is supported, as it should be, by taxation. Is it best to contribute to their support by the kind of subsidy that grants them special privileges in regard to certain classes of goods, at the same time making them dependent on foreign manufacturers; or by the very slightly increased taxation necessary to develop American independence in scientific instruments as in other lines of industry?

C. H. ASH

BUFFALO, N. Y.,

THE DIVISION OF ENGINEERING NATIONAL RESEARCH COUNCIL[1]

THE War Organization of the Engineering Division comprised four sections; a section on metallurgy, a section on mechanical engineering, a section on electrical engineering, and a section on prime movers. The work of each section was under a chairman, who was directly responsible to the chairman of the division.

The section on metallurgy had for its principal work the solving of metallurgical problems arising in connection with the conduct of the war, more particularly those brought to it by the military. This work was accomplished through the medium of committees, whose personnel included leading authorities upon metallurgy.

The section of mechanical engineering established a drafting room in charge of a chief draftsman at research council headquarters and through the generosity of the Carnegie Institute of Technology a machine shop at Pittsburgh under the direction of a foreman. These were used for the development of inventions referred to the section by the physics and engineering divisions.

The section on electrical engineering concentrated its efforts upon the problem of electric welding, more particularly electric welding as applied to ship building. This section worked in very close cooperation with the Emergency Fleet Corporation, who financed its investigative work.

The section on prime movers devoted its attention chiefly to the design and development of power plants for aircraft.

[1] Address given at joint session of the National Academy of Sciences with National Research Council, April 30, 1919, Smithsonian Institution, Washington, D. C.

The efforts of each section were so directed as to be of the greatest service in the solving of the problems of greatest immediate need to winning the war; each has to its credit important achievements during the war period.[2]

Reorganization of the engineering division on a peace basis has now been fully accomplished. The division consists of three representatives of each of the four founder engineering societies. The societies so represented being the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, and the American Society of Civil Engineers; further there is one representative each from the four more important non-founder societies. The societies so represented being the American Society for Testing Materials, the American Society of Illuminating Engineers, the Western Society of Engineers, and the Society of Automotive Engineers. In addition to the representatives of the engineering societies there are twelve members at large, making a total membership in the division of twenty-eight. The paid officers of the division are a chairman and a vice-chairman.

The work of the engineering division has gone steadily forward during the reorganization period and to such an extent that the newly organized division is now performing all its functions and begins its career, *a going concern.*

A plan of close affiliation of the division with the engineering foundation has recently been approved by the members of the foundation and the executive board of the National Research Council. By the terms of this agreement the engineering foundation will provide the engineering division an office in the Engineering Societies Building at New York, together with most of the necessary clerical force; further they will make appropriations from time to time of their funds to aid specific undertakings of the division. The location of the engineering division at this center of engineering activity and the close affiliation with the engineering foundation will be important contributing factors to the future development of the division.

At present the division is working largely through the medium of committees. It is common knowledge that it is easy to form committees, but difficult to get them to function properly. Very careful consideration has been given the problem of organizing the research committees of the engineering division. We have found that given an energetic chairman, who is master of his subject and who inspires confidence, an active group within the comittee to perform the necessary researches, a still wider group who may not have time to devote to research but who through breadth of experience are particularly well qualified to act in an advisory capacity, and last but not least the necessary funds, and important results are sure to follow.

Time will not permit of going into the work of the committees in detail. The work so far undertaken covers the fields of metallurgy, electrical engineering, mechanical engineering and to a less extent civil engineering.

The engineering division now has some fourteen committees at work upon various problems. At present fourteen states, extending from the Atlantic to the Pacific are represented and the number is rapidly increasing. Men connected with educational institutions, the military and civilian bureaus of the government and large manufacturing concerns are willing and even eager to serve upon these committees; in fact appointment to one of them is regarded as an honor.

The principal work of the engineering division is to stimulate and coordinate research. It is not to be regarded as an instrument of research, but rather as a stimulator and director of other instrumentalities of research which are brought together through the medium of committees. In suggesting, planning, and organising researches which other agencies carry out, it performs a valuable and unique service. It arouses interest where it did not previously exist, brings together agencies none of which for various reasons were able to do the whole of a research,

[2] See Report of the Academy of Sciences for the Year 1918.

but which are able and willing to contribute an important part of a research.

Galen H. Clevenger,
Acting Chairman of the Division of Engineering

SCIENTIFIC EVENTS

THE WATT CENTENARY[1]

Additional interest has been given to the forthcoming commemoration of the centenary of the death of James Watt by the movement just inaugurated in Glasgow to found locally a James Watt chair of engineering at the university. Birmingham engineers decided some time ago that a similarly named chair should be installed in the university of their city, besides holding a centenary commemoration and erecting an international memorial to the three great pioneers, Watt, Boulton and Murdock. The commemoration in Birmingham will be held on September 16–18. London, Glasgow, and Greenock, and, indeed, all parts of the country, are heartily cooperating, and, with few exceptions, the universities and scientific societies, together with many manufacturers and individual eminent men, are associating themselves with the scheme. In the Science Museum at South Kensington steps are being taken to arrange a comprehensive exhibition of Watt relics. In Birmingham the Watt relics existing there, which have so carefully been preserved by the forethought of Mr. George Tangye, and were a few years back presented to the city, will be completely rearranged and displayed with many additions. Two pumping-engines made by Boulton and Watt will be seen; one, the first sold by the makers in 1776, will be actually shown under steam, and raising water. A memorial service will be held in the Parish Church at Handsworth, where the three contemporaries are buried. A garden-party will be held in park at Heathfield Hall, where the garret workshop still remains as Watt left it. Lectures will be delivered by eminent men and a centenary dinner held. Some doubt seems to have been raised with regard to the claims of Birmingham to an international memorial. It should be remembered, however, that Watt's association with Boulton led to the success of his engine. Boulton's factory was famous for workmanship throughout Europe. It is true that Watt conceived his first ideas whilst working at the University in Glasgow, but he gained no practical success until he went to Birmingham. He spent the best part of his life there, including the evening of his days after he retired from business. The foundations he laid by scientific thought and careful study have resulted in the great and universal application of steam, and the appeal comes appropriately from Birmingham for an international memorial to him.

[1] From *Nature.*

THE SHORTAGE OF COAL IN EUROPE

The Bureau of Mines gives figures showing that western and southern Europe is badly in need of coal. The deficiencies in the several countries were supplied by Great Britain, which now faces a loss of its export business through reduction in its coal production. On a pre-war basis of consumption the following tabular statement gives the deficiency in the various countries in western and northern Europe which must be met by imports:

	Long Tons (2,240 lbs.)
France	20,000,000
Spain	3,650,000
Italy	9,650,000
Holland (other than supplies from Germany)	2,010,000
Sweden	4,560,000
Portugal	1,360,000
Norway	2,300,000
Mediterranean countries (other than Italy)	3,500,000
Denmark	3,030,000
Total	50,060,000

In 1913 Great Britain supplied 31,000,000 tons to north Europe; 32,000,000 tons to France, and south Europe, that is 63,000,000 tons to the above-named countries, and others, in Europe, in addition to which about 9,000,000 tons was sent to South America; and 5,000,000 tons to other parts of the world.

If the statements made before the Parliamentary Commission are correct, from the

most favorable point of view, as estimated by Sir Richard Redmayne, conditioned on maintaining of war-time restrictions on domestic consumption, Great Britain will be able to supply only 28,000,000 tons for export during the coming year, dating from July 16. If, on the other hand, the domestic consumption was on a pre-war basis, there would be but 7 million tons available. But, on the basis of Sir Reymayne's figures, if all the coal were shipped to western and southern Europe, there would be a deficiency of over 25,000,000 tons without considering the 14,000,000 tons that Great Britain, in 1918, supplied for other parts of the world. There is thus a total deficit of approximately 40,000,000 tons, which if it is to be supplied at all, can be supplied by America only, on the assumption that Westphalia and Belgium are unable to materially increase production for several years. At best there is evidently a very large amount of coal that the United States could and should supply to relieve the situation in Europe and in South America, now that there is likely to be enough shipping flying the American flag to take care of the business.

THE PROPOSED MEDICAL FOUNDATION FOR NEW YORK CITY

ANNOUNCEMENT has been made by Dr. Royal S. Copeland, health commissioner of New York City, of an organization to be known as the New York Association for the Advancement of Medical Education and Medical Science.

The association's constitution and by-laws have already been adopted and an application has been filed at the Secretary of State's office in Albany for a charter. Dr. Wendell C. Phillips, ear specialist and general surgeon for Bellevue Hospital, is the president, and Dr. Haven Emerson, formerly health commissioner of New York, is the secretary.

Dr. Phillips, who is the originator of the project, planned before the war for an institution that would at least rival Vienna and Berlin. The world conflict postponed the matter, but as soon as the armistice was signed the physician and those interested with him revived the plan. A meeting was held on April 10, at which prominent medical men gave their views, and a committee was appointed to deal with the matter.

As stated in the constitution of the association, there are four primary objects to be attained. There are: First: To improve and amplify the methods of graduate and undergraduate teaching. Second: To perfect plans for utilizing the vast clinical material of the city for teaching purposes and to make use of teaching talent now unemployed. Third: To bring about a working affiliation of the medical schools, hospitals and laboratories, as well as the public health facilities of the city, to the end that the best interests of medical education may be conserved. Fourth: To initiate the establishment of a medical foundation in New York City whereby funds may be secured to meet the financial requirements of all forms of medical education and investigation.

There will be two classes of membership in the organization, one a general membership, including all physicians in good standing, teachers of auxiliary sciences, and investigators of problems relating to medicine; the other, a corporate membership of medical teachers and medical men with hospital appointments or affiliations. The corporate membership is limited by the constitution to not over 150.

The physicians who are responsible for the plan issued a short statement, which was given out at the board of health offices, in which they said:

For years it has been evident that medical education, both undergraduate and graduate in New York has not adequately represented the possibilities of this great city. One of the reasons for this state of affairs has been the lack of financial support for our medical institutions. A more potent reason, however, arises from the fact that individual institutions working along somewhat narrow lines have accomplished satisfactory general results. The larger possibilities which could only come from a more or less central organization have failed to materialize.

As a result, men seeking medical education have been obliged to seek medical centers in European countries where more individual and special courses could be secured with but little trouble.

It is a historical fact that after every great war, the medical center of the world is changed and the war just over will be no exception to the rule. In line with these ideas and in order to give New York City this opportunity to at least become one of the leading teaching medical centers of the world, our organization has been formed.

In addition to Dr. Phillips and Dr. Emerson, the following compose the officers of the association: Dr. George D. Stewart, president of the New York Academy of Medicine, first vice-president; Dr. Glentworth Butler, chief medical consultant of the Long Island College Hospital, second vice-president; Dr. Arthur F. Chace, stomach specialist of the Post-Graduate Hospital, treasurer. The trustees are Colonel Charles H. Peck, Dr. William Francis Campbell, Dr. John E. Hartwell, Dr. Frederick Tilney, Dr. Otto V. Huffman, Dr. Adrian Lambert, Dr. Samuel A. Brown, Dr. James Alexander Miller, and Dr. George W. Kosmak.

THE PHILADELPHIA MEETING OF THE AMERICAN CHEMICAL SOCIETY

Owing to the great advances made by American chemistry as a result of the European war, the fifty-eighth meeting of the American Chemical Society to be held in Philadelphia from September 2 to 6 inclusive will be undoubtedly the largest ever held by that organization.

The membership which has increased nearly twofold since 1914 is now 13,600 and is being augmented every month. The sessions which are to be held at the Bellevue-Stratford will touch upon problems of reconstruction growing out of developments which place the American chemist so much on his own resources both for materials and apparatus with the closing of foreign markets.

One of the features of the meeting will be the first session of the newly organized dye section. There will be a joint session of this section with the Division of Industrial Chemists and Industrial Engineers to consider a proposal to revise the patent laws. It has been suggested the charging of nominal annual renewal fee would compel many patentees to work their patents, rather than to permit them to be idle for many years.

Special arrangements have been made to give to all delegates access to the chemical plants of Philadelphia. There will also be an excursion on the Delaware River which will give them the opportunity of viewing the munition works erected in that region. The conversion of such establishments to the ways of peaceful industry will come up in various aspects before divisions of the society.

The provisional program is as follows: September 3, council meeting and dinner to council tendered by the Philadelphia Section; September 3, general meeting, with addresses by Newton B. Baker and other distinguished speakers; followed by divisional meetings; September 4, divisional meetings and president's address, by Dr. William H. Nichols, at the Museum of the University of Pennsylvania. September 5, divisional meetings and banquet in the evening at Bellevue-Stratford, the program to conclude on the sixth with excursions and automobile trip to Valley Forge.

The Philadelphia Section urges that members write now for hotel accommodations.

SCIENTIFIC NOTES AND NEWS

Dr. Abraham Jacobi, the distinguished physician and author, professor emeritus of diseases of children in Columbia University, died on July 11, in his eighty-ninth year.

Professor Albert A. Michelson, head of the department of physics at the University of Chicago, has been appointed to the rank of commander, U.S.N.R.F. He served as lieutenant commander in the Bureau of Ordnance of the Navy Department at Washington during the war.

The Royal Geographical Society has conferred its patron's medal on Professor William Morris Davis for eminence in the development of physical geography.

Professor H. Gideon Wells, of the department of pathology of the University of Chicago, has been decorated with "the Star of Roumania" by the King in recognition of his work as head of the American Red Cross Mission to Roumania.

AT the May meeting of the American Academy of Arts and Sciences, Professors Joseph Lipka, G. A. Miller, F. R. Moulton and Virgil Snyder were elected fellows in the Section of Mathematics and Astronomy.

THE University of Aberdeen has conferred the honorary degree of LL.D. upon Emeritus Professor Cash, recently retired from the chair of materia medica in the university, and on Emeritus Professor Japp, who retired from the chair of chemistry five years ago.

VILHJALMUR STEFANSSON, the Arctic explorer, has been awarded the La Roquette gold medal of the Geographical Society of Paris. The award is in recognition of discoveries made by the Canadian Arctic expedition, commanded by Mr. Stefansson during the years 1913–18.

MAJOR-GENERAL WILLIAM C. GORGAS, formerly Surgeon-General of the United States Army, and, after his retirement, director of the yellow fever work of the International Health Board, has returned from a trip to South America in an endeavor to determine the seed beds of yellow fever, and institute systematic measures to destroy the disease at its source.

PROFESSOR WILLIAM ALANSON BRYAN, of the College of Hawaii, left Honolulu recently for a two years' tour of the South Pacific Islands to collect zoological data which might throw light on the history of the great continental land mass supposed to have existed there in past ages. Professor Bryan is an authority on mollusca and will devote most of his energies to collecting land shells.

DR. FRANK E. BLAISDELL, SR., of Stanford University, and Mr. E. P. Van Duzee, curator of the entomological department of the California Academy of Sciences, will spend their summer vocation, studying the entomological fauna of the Lake Huntington region, Fresno county, California, at an elevation of 7,000 feet.

DR. LYNDS JONES, head of the department of animal ecology, at Oberlin College, left on June 20 with a party of 22 for an ecological expedition to the Pacific coast. The party will return to Oberlin on September 1.

DEAN HARRY HAYWARD, who served as director of the college of agriculture in the A. E. F. University at Beaune, France, has returned to the United States and has assumed his duties as dean and director of the agricultural department of Delaware College.

DR. JOHN K. KNOX (Chicago, 1917), formerly geologist on the Canadian Geological Survey and later for some years on the staff of the Roxana Petroleum Company, has been appointed assistant state geologist of Kansas. He will have special charge of the oil and gas investigations of the survey. Several parties are now engaged in field work.

DR. E. A. BAUMGARTNER has resigned as associate in anatomy in the Washington University medical school, St. Louis, and accepted a position with Dr. A. E. Hertzler at the Halstead Hospital, Halstead, Kansas.

THE General Bakelite Co. has provided the funds for an industrial fellowship in the department of chemical engineering of Columbia University. This fellowship differs from the general type of industrial fellowships in that in addition to the amounts paid to the fellow and for the chemicals and apparatus used by the fellow, an additional sum is paid to the university to compensate it for the use of the laboratories and other facilities used by the worker. A further difference is that no time or other limitation is put upon the publication of the results of the investigation. Mr. Mortimer Harvey has been appointed to the General Bakelite Co. fellowship for 1919–20.

MR. GEORGE BARSKY has been appointed to the Bridgham fellowship ($1,500) at Columbia University for the year 1919–20. He will work in the department of chemical engineering with Professor McKee on the utilization of the waste liquor from sulphite pulp mills. Mr. Barsky received the degree of chemical engineer in 1918 from Columbia University.

MR. HENRY M. MELONEY, of Bordertown, N. J., who was graduated from the New York State College of Forestry, at Syracuse University, with the degree of B.S., in June, 1919, has just accepted appointment to a technical fellowship for the study of forestry, lumber-

ing and paper and pulp manufacture in Sweden under the American-Scandinavian Foundation. Ten college and university men from America will be sent to the Scandinavian states under the American-Scandinavian Foundation for study and research. Two of these fellowships are in forestry and the others in mining, electrical engineering, etc. The fellowships carry $1,000 and are of one year's duration.

Professor Robert Andrews Millikan, of the department of physics of the University of Chicago, and recently vice-chairman of the National Research Council in Washington, will lecture before the summer session of the university on July 25 on "The New Opportunity in Science."

We learn from *Nature* that an additional meeting of the Royal Astronomical Society was planned for July 11, to receive American astronomers who are on their way to Brussels to take part in the conference of the International Research Council, which will be opened there on July 18. The party is expected to include Professors Campbell, Eichelberger, Mitchell, Schlesinger, Stebbins, Adams and Boss.

The *Jahresbericht der Deutschen Mathematikir-Vereinigung*, as we learn from the *American Mathematical Monthly*, reports the deaths of the following mathematicians: Professor A. Benteli, of the University of Bern, on November 10, 1917, in his seventieth year. Professor E. Ott, of the University of Bern, on November 17, 1917, in his seventieth year. Dr. Robert Jentzch, of the University of Berlin, on March 21, 1918, fallen in battle. Professor M. B. Weinstein, of Berlin, in his sixty-fifth year. Professor G. Veronese, of the University of Padua, on July 17, 1917, in his sixty-third year. François Daniëls, of Nymwegen, Holland, professor of mathematics at the University of Fribourg, Switzerland, died on November 16, 1918, at the age of fifty-eight years.

In accordance with the trust founded by Mrs. Eliza Streatfeild for the promotion of research in medicine and surgery, a committee of the Royal College of Physicians of London and of the Royal College of Surgeons of England is proceeding to appoint a Streatfeild research scholar. The emolument will probably be £250 per annum, and the tenure of the scholarship three years at the discretion of the committee. Applications, which should state the nature of the proposed research, the place where it will be carried out, and the status of the applicant, should be addressed to the Registrar, Royal College of Physicians, Pall Mall East, S.W.1, and marked "Streatfeild Scholarship."

An inter-Allied Conference of Associations of Pure and Applied Chemistry was held in Paris on April 14 and 15. The conference has laid the foundation for an inter-Allied Chemical Association, to replace the International Association of pre-war times. Details of their decisions have not been made public. The program, however, is said to meet with the unanimous approval of all the delegates. Among the 350 guests present at the banquet were Lord Moulton; Sir William Pope, president of the British Federal Council; Professor Henry Louis, who was head of the British delegates, Mr. Henry Wigglesworth, the chief American delegate; Professor Chavanne, president of the Chemical Society of Belgium; Professor Paterno, vice-president of the Italian Senate; Professor Moureu, M. Paul Kessner, and M. Poulenc, presidents of the three principal French associations of applied and pure chemistry, and many other well-known men in the chemical and industrial world.

Besides supplying an important war need, according to the London *Times*, Sheffield has laid the foundation of a future industry by the progress made at the university in the manufacture of glass for laboratory purposes. In the summer of 1914 there was no manufacturer of laboratory glass in Britain. The whole process, the knowledge of which had been built up in Germany during the last half century, had to be discovered and workers specially trained. Laboratory glass was urgently needed in the manufacture of certain munitions and important and urgently required equipment would have been held up if it had not been supplied.

Nature says: "The facts made known by Lord Gainford and Lord Harcourt in the House of Lords on February 26 show that a long time must elapse before our museums and the staff of the Board of Education can resume their work unhindered. The latter body is scattered throughout London, while its records are stored in the galleries of the Victoria and Albert Museum. Half that museum is closed to the public, its circulation department shut down, its textile classes and other aids to industry suspended. The priceless Wallace collections are still in underground tubes. The National Portrait Gallery, the London Museum, the Tate Gallery and the British Musuem galleries of prints and of Egyptian and Assyrian antiquities, as well as much of its storage space, are occupied by huge clerical staffs. Finally, the exhibition gallaries of the Imperial Institute continue to be filled with a succession of other departments; the institute's lectures and demonstrations are in abeyance and its own research work is hampered because the raw materials are stored elsewhere. The result is not only to disappoint the American and Dominion troops, and to deny the British taxpayer the enjoyment of his great educational establishments; it is, above all, a serious check on the commercial and industrial development of the country. Unavoidable the delay may be, yet we can not help feeling that the situation would not have arisen had ministers a truer appreciation of the work done by and in our public museums."

UNIVERSITY AND EDUCATIONAL NEWS

THE gift of a chemical laboratory to Cornell University has already been announced. In a recent address President Schurman quoted the words of the anonymous donor: "I will provide you with a chemical laboratory, fully adequate to the needs of the university, and one that will in all respects and size be the best there is in America." It is said that the laboratory may cost $1,500,000 and that the new building will be placed where President Schurman's house now stands.

PRINCETON UNIVERSITY receives $50,000 by the will of the late Arthur Pemberton Sturges, and $10,000 by the will of the late Samuel K. Martin.

PROFESSOR DEXTER S. KIMBALL has been elected chairman of the faculty committee on organization of the College of Engineering of Cornell University, which will combine the two existing colleges. He was also elected dean of the new college upon its organization in 1921, when Dean Haskell and Dean Smith will retire by reason of having attained the age of sixty-five years.

ASSISTANT PROFESSOR W. S. FOSTER, of the department of psychology, of Cornell University, goes to the university of Minnesota as full professor.

DR. ARTHUR W. HIXSON has been appointed associate professor of chemical engineering at Columbia University. Professor Hixson was formerly associate professor of industrial chemistry and metallurgy at the University of Iowa, but for the last year he has been in the Ordnance Department at Washington, Dr. J. J. Morgan, assistant professor of chemistry at Stevens Institute of Technology, Hoboken, N. J., has been appointed assistant professor of chemical engineering.

AT Lehigh University Ralph J. Fogg, a member of the civil engineering department for eleven years, has been appointed professor of civil engineering and head of the department, and Dr. Fred V. Larkin, for the past four years assistant superintendent of the Harrisburg Pipe and Pipe Bending Company, has been appointed professor of mechanical engineering and head of the department.

AT Rutgers College P. H. Van der Menlen, Ph.D., has been appointed assistant professor of chemistry; Geo. W. Martin, M.A., assistant professor of botany; Thurlow C. Nelson, Ph.D., assistant professor of zoology, and T. Alan Devan, M.D., professor of hygiene and sanitary science.

LIEUTENANT-COLONEL FRANK D. ADAMS has returned from Europe for the purpose of as-

suming the position of acting principal of McGill University.

At McGill University Captain S. E. Whitnall, demonstrator of human anatomy, Oxford, has been appointed professor of anatomy, and John Tait, lecturer in experimental physiology in the University of Edinburgh, professor of physiology.

DISCUSSION AND CORRESPONDENCE

THE HISTORY OF SCIENCE AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

To the Editor of Science: From the discussions taking place concerning the history of science, and from the opening up of other unexplored fields of thought and research, it is happily only too evident that this country is once more approaching peace conditions and looking forward to greater things—among them, a fundamental position in education and science.

The letters in Science, April 4, by Dr. Felix Neumann, and May 9 by Dr. George A. Miller, have simply expressed a phase of the current of thought passing through our revision of ideas concerning the importance of science, study and research—all tending to a broader cultured type of scientific learning. It is not so much as emphasizing a national characteristic in the great international unification of learning, but as developing a new epoch in the history of science itself. In the words of Dr. George Sarton—we must try to reconcile idealism and knowledge, science and art, truth and beauty—the ability of every one to do so is the real measure of his education. In the last analysis it is the message of the New Humanism.

For this reason, if for no other, the study of the history of Science is to be encouraged, and no greater impetus can be given to it than by a full recognition of this new Section "K" by the American Association for the Advancement of Science.

This matter was broached during 1915 in an article in Science[1] which resulted in a number of letters giving encouragement, but like all such advancing ideals, not pertaining to the war, it made no progress.

The writer wrote to Dr. J. McKeen Cattell, editor of Science, concerning this proposed Section in the American Association for the Advancement of Science and in reply the following statement was received.

> I should think that there would be a good deal to be said for a section of the American Association for the Advancement of Science devoted to the history and methods of science. It might be best to begin with a sub-section under the section of anthropology and psychology, and it could be seen whether enough interest were taken to justify the establishment of a section. The best plan would doubtless be to correspond with those interested and then present a statement to the council of the association.

In another letter, quoting from Dr. Lynn Thorndike, Department of History, Western Reserve University, a proposition was advanced for the same purpose—namely, to call together a group of interested persons (no matter from what field of research) to discuss plans for an organization to be affiliated with the American Association for the Advancement of Science. Therefore, it might be said that the time is propitious for such an organization, especially as we will note further from other facts.

Dr. Neumann's plan for Section "K" would attract not alone scientists, but also historians of the social, economic and political science groups. Philosophers too, would no doubt be interested. This, then, would tend to make the American Association for the Advancement of Science an "encyclopedic" organization.

In Dr. Neumann's letter to Dr. Howard, he emphasizes the principle of "nationalism" by making the purpose of the section to the study of the history and progress of science in America alone. Much valuable work can be done here, to be sure, "but can we afford to neglect the centuries gone before?" Nor has Dr. Neumann mentioned what historical work has been done in the United States already. These attempts are worthy of mention, since they form a beginning and stepping stones as well as examples for other fields

[1] Science, N. S., Vol. XLI., No. 1053, March 5, 1915, pp. 358–360.

to follow. The pioneer work of George Brown Goode shows what is possible, brief as his studies were. The following titles will show the best that has as yet been accomplished, especially in the specific sciences.

In chemistry we have Dr. E. F. Smith, "Chemistry in America," and his "Life of Robert Hare"; G. P. Merrill's "Contribution of the History of American Geology," published by Smithsonian Institution, 1906, and Florian Cajori's "The Teaching of History of Mathematics in the United States," published by the U. S. Bureau of Education, 1890. Cajori's treatise is somewhat old, but still an excellent text, both in mathematics and astronomy for the period it covers.

In astronomy no definite history has yet been written. A number of addresses and papers have attempted to outline its history, and a number of biographical sketches give a good cross-section of a period. A history of astronomical progress in this country is urgently needed, since for the last decade we have attained the most prominent position, and the war will leave us undisturbed for generations to come.

Brief mention should be made of a very recent work entitled "A Century of Science in America, 1818–1919" by E. S. Dana. This, however, only covers the field of geology, mineralogy, physics and biology during this period.

A forecast of the possibilities of research and study, may be made by observing what has gone on before. In the matter of resources for research in the great libraries of the country, one library whose efforts have been fairly well directed towards this end is the John Crerar Library. The publications entitled "List of Books upon the History of Science and the History of Industry" serve as excellent bibliographical aid for the student in the history of science. For the study in the history of mathematics, undoubtedly Columbia University, under the leadership of Dr. E. D. Smith, offers good sources. In chemistry and physics, Pennsylvania, Yale and Harvard universities have excellent material. For astronomy, Harvard University library offers riches untold in the Colonial period, and Harvard Observatory for the material beginning in the early nineteenth century.

As a further indication of the times, our universities and colleges have recognized to an encouraging extent the great worth of courses pertaining to the development and evolution of the sciences.[2] The courses thus established are varied and numerous, as well as the methods of instruction and text used.

In view of what has been said concerning the subject of astronomy, it is interesting and worthy of note to call attention to the fact that courses in the history of astronomy in America have been established. Also within the last two years the University of California has established a chair devoted entirely to the history of mathematics.

Again attention should be drawn to the matter of text and treatise published in the country. Within the last two years there have appeared two books, "The History of Science," by Dr. W. Libby, and a second by Sedgwick and Tyler, entitled, "A Short History of Science."

We have also within our borders to-day the greatest authority in the field of history of science, Dr. George Sarton, of Ghent, Belgium. Dr. Sarton has lectured upon this subject in nearly all of the universities of the eastern and middle western states, and has been lecturer for two years in the department of History of Science at Harvard University, and is now research scholar in the Carnegie Institution.

We are well aware of a movement to establish in the United States an institute devoted entirely to the research and advancement of the history of science and civilization.[3] Also, recently we have been informed that *Isis*, the international journal of history of science[4] is to resume publication in all probability in this country.

[2] SCIENCE, N. S., Vol. XLII., No. 1091, November 26, 1915, pp. 746–760.

[3] SCIENCE, N. S., Vol. XLV., No. 1160, March 23, 1917, pp. 284–286. See also Vol. XLVI., No. 1191, October 26, 1917, pp. 299–402.

[4] SCIENCE, N. S., Vol. XLIX., No. 1259, February 14, 1919, pp. 170–171.

One of the great significant facts for the future to consider, and which will appeal to our patriotic spirit of attainment, is that the history of the great war must be written in terms of scientific discoveries and research. What part is the history of science to take in this achievement? What is the spirit of philosophy to bring forth from such a study? One fact is certain of emphasis, that the progress of science, national and international, must be cooperative. Not alone has the war taught us this, but the spirit of idealism, which we have fought to maintain, must be carried on.

All these facts are mentioned to show the spirit of the times, and now that this country has attained such a position of worth, the American Association for the Advancement of Science can give no greater encouragement to this idealism, to the philosophy of science, to the final meaning of education and culture, then by placing its approval upon the adoption of Section "K" to be known as the History of Science Section. FREDERICK E. BRASCH

JOHN CRERAR LIBRARY,
CHICAGO

THE NEEDS OF PALEOBOTANY

WHAT paleobotany most needs is men. The dearth of men conversant with fossil plants, not merely in America, but taking the world over, is to be deplored. Nathorst, the eminent Swedish paleobotanist, in a recent letter emphasizes this fact. Thin as it has been at all times, the paleobotanic rank and file has been all but decimated. The war seems to have hastened the end for three of the older men who adorned everything they touched—Zeiller and Lignier, of France, and Solms, of Strasburg. The career of the young and promising Fernan Pelourdé closed on the field of battle; and as heroic was the end for Ruth Holden in Russia. We lament too E. A. Newell-Arber, the course of whose life was also shortened by the war. To offset these great losses there have been no accessions abroad and the only younger worker who has definitely joined the paleobotanic ranks in this country during the past dozen years is Harvey Bassler. The American contributors in paleobotany, older and younger, are Hollick, Knowlton, David White, Jeffrey, Berry, and Sellards. All first came into notice twenty or more years ago, and both Sellards and White seem wholly lost to other interests, or to survey or executive duties.

Let any one think for himself what such a slender margin means to a great subject of growing and world-wide interest. What a lack there is of timely papers, of exploration in the field in a hundred horizons and a thousand important localities in both North and South America. Consider too, where the workers are so few and the field continent wide, what a lack of healthy criticism there must be. Without vigorous and knowing criticism small facts pass for great ones, and great principles and facts of far reaching import, whole categories of evidence, are left for long years unnoted. This is not the way to do the world's meed of work. Furthermore, progress in paleobotany peculiarly depends on the examination as far as practicable of the world's forests and fossils. Restriction is, more than in any other subject, fatal because of the exceedingly variable types of fossil plant conservation.

It is not within the present limits to go into any detailed account of the greater climatic and geologic problems, the solution of which awaits the work yet to come in the broader field of paleobotany. A suggestive account of the relations of paleobotany to botany was given by Professor Coulter in an address a few years ago.[1]

It is, however, well to recall several of the limits to the investigations of past floras as they stand to-day. Firstly, there can be no question that the indices of phytological form are many and valuable when properly combined. Yet not merely the paleobotanists, but the *botanists* have left the fine "nature prints" (better than the leaves themselves for comparison) just where the work of Ettingshausen closed about sixty years ago. And this, notwithstanding the fact that for years those

[1] Reprinted in *American Naturalist*, 1912, pp. 215–225.

engaged in broader forest study, especially in the tropics, have felt the severest need for ready or approximate identification by leaf characters. Secondly, an adequate study of fossil stems systematically collected, and including wherever possible to obtain, the circum-medullar region has never been even begun. Thirdly, the signal success with which Professor Nathorst has developed a chemical treatment of carbonized remains so that collodion imprints of many histologic features may be had, affords such an all-important factor of control that many of the longer known floras require restudy as a whole, or in part by this method. It is not probable that classification can be safely based on features disclosed by the "chemical method"; but as an aid in determining genera or species it is effective, often in the case of rather fragmentary material. Fourthly, the improved methods of sectioning coals, and fragmentary stems like those of the Kreischerville conifers, as developed by Jeffrey, indicate a great extension of exact study following more searching collection afield.

Under the circumstances we should have on at least ten of our surveys, and in at least a dozen of our larger universities thoroughly equipped paleobotanists. And need I call attention to the fact that the scientific requirements are severe? A good paleobotanist needs geologic and paleontologic, as well as botanic training, and above all things he needs to be not merely an expert in the laboratory but a rugged and determined field worker and collector. Such men have to be given position. Subsidiary activities, and foreshortened results, are apt to be near neighbors. Though the comparison be invidious, it yet requires to be made. In their larger collecting schemes both the invertebrate and vertebrate paleontologist constantly spend in collection and reconnaissance sums such as have never been even relatively available for work in the fossil plants not one whit less important.

In closing I would like to call attention to a point of concrete value. According to the interpretations of evidence which have thus far had acceptance, there results a lack of forest making types from the Trias to the close of the Jura. But if, as now seems apparent, the cycadeoids have a degree of angiospermous affinity, the microphyllous forms must often represent important elements in unrecognized forests. If so, many of the forms probably had the same capacity to thrive in temperate to colder climates as the dicotyls they often accompany, especially in the puzzling association noted by Hollick in the Kenai flora of Alaska.[2] This flora must have flourished near to snow fields and glaciers. The cold presaging the bipolar ice caps may therefore have come on far earlier than has been hitherto unquestioningly believed. This, with the new methods of study, and especially the more persistent scanning of the broader outlines of plant succession, is only one of the many problems which await development of paleobotany.

G. R. WIELAND

GRAVITATIONAL ATTRACTION AND URANIUM LEAD

TO THE EDITOR OF SCIENCE: As shown by Professor Theodore W. Richards in his presidential address,[1] it has been found that the last known disintegration product of the uranium series, uranium lead, behaves in all respects like ordinary lead, with the exception that it is slightly radioactive and has an atomic weight of about 206.1, as compared with that of ordinary lead, 207.2. It has also been found that lead derived from uranium minerals usually shows some value between the above limits and thus appears to be a mixture of the two former kinds. None of the many attempts made to effect a separation has, however, met with success, nor has any theory been advanced by which the discrepancies in atomic weight, which seem quite without a parallel among the other elements, may be satisfactorily explained.

The possibility suggests itself that the discrepancies referred to might be due to a slightly different behavior of the various forms

1 "The Problem of Radioactive Lead," SCIENCE, January 3, 1919.

2 See *American Journal of Science*, IV., 31, April, 1911, pp. 327–330.

of lead toward the force of gravitation. Whether or not this is so may easily be ascertained through physical tests which might preferably be in the nature of comparative pendulum measurements, lead derived from uranium ore being obtainable in sufficient quantities for the purpose.

The generally accepted law according to which the ratio of weight to mass has a fixed value in the same locality, irrespective of the nature of the substance, is largely empirical, as there are a number of elements for which the law has never been proved. Considering the very irregular distribution of other properties, like magnetism and radioactivity, among the elements it would not be surprising if deviations were found to exist in their gravitational properties as well.

From this point of view, *i. e.*, if deviations actually exist in the value of gravitational acceleration for the various forms of lead, the chances are that the value in any case will be proportional to the atomic weight, as in this instance the atomic mass, being the ratio of either, would come out the same for all forms of lead. Such a result would go far toward reconciling the discrepancies in atomic weight with already established theories, because what is really of interest, both from a physical and chemical standpoint, is not so much the weight of the atom as its mass. Weight is only an attribute of mass, the latter having long been recognized as the more basic entity.

The theories on gravitation are still in a crude shape, but if the attraction is assumed to be due to the movements of the electrons constituting the atoms a possible deviation in the gravitational attraction of uranium lead might perhaps be ascribed to a gradually subsiding state of tension or agitation among the electrons, caused by the splitting up of the atoms during the radioactive processes, conditions being thus comparable to those supposed to obtain in a permanently magnetized piece of steel. On this assumption uranium lead would, in course of time, increase in atomic weight, changing slowly into ordinary lead, while the lead derived from various uranium minerals might properly be considered as representing intermediate stages in this process of relaxation.

ANDERS BULL

BROOKLYN, N. Y.

WORKING UP IN A SWING

To THE EDITOR OF SCIENCE: Mr. A. T. Jones has an article on this subject in the current volume of SCIENCE, p. 20, July 4, 1919. In the beginning he makes a statement as follows:

> As I do not recall ever seeing any discussion of this matter, the following note may not be out of place.

I wish to call Mr. Jones's attention to E. J. Routh's "Dynamics of a System of Rigid Bodies" (Macmillan), Vol. I., Art. 287, entitled "Examples of Living Beings." In example 6 he will find a complete solution of his problem, with the necessary mathematical equations.

V. KARAPETOFF

CORNELL UNIVERSITY,
July 8, 1919

To THE EDITOR OF SCIENCE: The letter in SCIENCE of July 4, by Professor Arthur Taber Jones, on "working up" in a swing, recalls to the writer that while studying the problem several years ago he found several references to the subject.

In the *Zeitschrift für physikalischen und chemischen Unterricht,* 16, 230 1913, H. Lohmann describes an apparatus by means of which the process of "working up" may be demonstrated. This consists of a plunger electromagnet, suspended as a pendulum, with its axis vertical. Raising and lowering the center of gravity of the suspended mass is accomplished by means of a key which controls the position of the plunger within the solenoid. The circuit is closed, and the plunger (and therefore the center of gravity) is raised when the key is in the "up" position; the plunger drops a short distance when the key is depressed. By imagining himself in a swing, the operator has no difficulty in so manipulating the key that the raising and lowering of the center of gravity of the swing-

ing mass are properly timed to bring about the increasing amplitudes.

The subject is treated analytically in the same journal by A. Hartwich, Vol. 17, 27, 1914. He arrives at an expression identical with that for Kepler's second law.

PAUL E. KLOPSTEG

PHILADELPHIA,
July 9, 1919

SCIENTIFIC BOOKS

Sewage Disposal. By LEONARD P. KINNICUTT, late Director Department of Chemistry, and Professor of Sanitary Chemistry in the Worcester Polytechnic Institute; C.-E. A. WINSLOW, Professor of Public Health in the Yale School of Medicine and Curator of Public Health in the American Museum of Natural History, New York, and R. WINTHROP PRATT, Consulting Engineer, M.Am. Soc.C.E. Second Edition, rewritten. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. Cloth; 6 x 9 in. Pp. 547. Illustrated. $4.00.

The first edition of this book which was reviewed by the writer in SCIENCE, February 10, 1911, Volume XXXIII., page 222, has been a successful reference book for students studying the fundamental principles of this branch of municipal sanitation. The present edition has been thoroughly revised and increased in size by about one hundred pages.

Progress has been rapid during recent years in this branch of the field of municipal sanitation. The revision of this book is timely as it is generally recognized that activities along this line, retarded by the world war, will shortly be taken up again with renewed vigor.

The style of the book is attractive and it is well arranged for use in the class room. Fundamental principles are clearly stated and use is made liberally of practical illustrations drawn from various important documents and investigations not only in this country, but abroad.

In bringing the book up to date, attention has been paid in particular to the activated sludge process, the two-story tank for the removal of suspended solids, with a comprehensive recital of advantages and disadvantages as now understood, and improvements in the fine screening of sewage, and progress in disposal of sewage sludge and the recovery of grease and fertilizing constituents from these waste products. Investigations conducted on a comprehensive scale at Cleveland, Chicago, Milwaukee and New Haven are described with summaries of results, as published. One of the merits of the book is that it is written from the viewpoints of the engineer, the chemist and the bacteriologist, thus bringing out for the consideration of the sanitarian and student the general principles of the subject from the angles stated, as is necessary in order to appreciate the practicability and efficiency of the respective methods.

The authors deserve commendation for their temperate statements on topics where current literature shows differences of opinion due presumably to variations in local conditions not as yet fully understood.

Little attempt has been made to set forth completely the most recent results obtained from the operation of plants most lately installed in this country. This may prove disappointing to some who devote themselves entirely to work in this particular field, but it is probably wise on the part of the authors to base a book for class room use on the broad historic background which as stated in the preface, forms the surest basis for real comprehension of the general principles of the subject as now understood. Teachers and students of this subject should welcome this new volume.

GEORGE W. FULLER

SPECIAL ARTICLES

THE POSSIBLE PRESENCE OF CORONIUM IN HELIUM FROM NATURAL GAS

ONE of us (Cady), with McFarland,[1] observed a number of lines in the spectra of samples of helium obtained from natural gas which did not belong in the spectra of helium,

[1] Kansas University Geological Survey, "The Composition of Natural Gas," p. 264.

[2] *Proc. Roy. Soc.*, 67, 467, 1901.

neon or hydrogen. These lines have been repeatedly observed in specimens of helium from that day to this. Living and Dewar[2] had observed some "wild" lines in specimens of Bath gas and suggested the possibility of the presence of coronium. In this connection it is interesting to note that some of the faint lines observed by us visually do correspond closely in wave-length to the coronal lines. During the past winter we have been making rather careful visual observations and find that some of the stronger of these lines belong to the swan spectrum of carbon, and are evidently due to some compound of carbon which is not completely absorbed by cocoanut charcoal at liquid air temperatures. These carbon lines are recorded in the literature as bands, but under the conditions under which we observe them appear to be sharp lines. We are adding to our equipment a quartz spectrograph for photographic observations and have under way a systematic fractionation of helium, using a number of methods, with the hope of eliminating the troublesome carbon compounds and of concentrating the unknown source of these remaining fainter lines sufficiently to enable them to be identified and thus prove or disprove the presence of coronium.

Hamilton P. Cady,
Howard McKee Elsey
University of Kansas,
Lawrence, Kansas

THE IOWA ACADEMY OF SCIENCE

The Iowa Academy of Science held its meetings in the Chemistry recitation room of the Science building of the State Teachers College at Cedar Falls, beginning at 1:30 P.M., Friday, April 25. After the preliminary business session and the general program section meetings were held. President Beyer gave his address on "Some problems in conservation" at the general meeting on Friday afternoon.

The following officers were elected for the coming year: *President*, T. C. Stephens, Morningside College, Sioux City. *First Vice-president*, Nicholas Knight, Cornell College, Mt. Vernon; *Second Vice-president*, D. W. Morehouse, Drake University, Des Moines; *Secretary*, James H. Lees, Iowa Geological Survey, Des Moines; *Treasurer*, A. O. Thomas, State University, Iowa City.

At 6:45 Friday evening a special war film was exhibited for the benefit of the academy and following this the evening was devoted to a résumé of the work of members of the academy during the war. President and Mrs. Seerley held a reception for the academy members after the meeting.

Sectional meetings were resumed Saturday morning and the business session closed the meetings. The members lunched together at 1:30 P.M.

The Iowa Section, Mathematical Association of America, held its fourth annual meeting Saturday forenoon, beginning at nine o'clock.

TITLES OF PAPERS

Zoology and Allied Subjects

A list of the birds found in Marshall county, II.: Ira N. Gabrielson.

The resistance of streptococci to germicidal agents: Henry Albert.

The correlation of art and science in the museum: Homer R. Dill.

Variations in the branches of the coelic artery in the rabbit: H. R. Werner.

An ecological survey of Dry Run, a small prairie stream. (1) The fishes: E. L. Palmer.

Animal tracks, food and disposition: is there any relation? E. L. Palmer.

Some zoological notes from the Barbadoes-Antigua expedition: C. C. Nutting.

Some interesting insect habitats in the tropics: Dayton Stoner.

Grasshopper control in Iowa: H. E. Jaques.

Some notes on the Cercopidae with descriptions of new species: E. D. Ball.

Thomisidæ of the Ames region: Ivan L. Ressler.

Notes on the occurrence of warts on cotton-tail rabbits in Iowa: J. E. Guthrie.

Medical work in the war: D. J. Glomset.

Variations in the branches of the carotid artery in the rabbit: Francis Marsh Baldwin.

Botany

Notes on the distribution of grasses of Iowa, Wisconsin, Minnesota and the Dakotas with reference to rust: L. H. Pammel.

Notes on the barberry: L. H. Pammel.

The genus Lactuca in Iowa: R. I. Cratty.

The rust on mammoth clover: W. H. Davis.

The moss and lichen flora of western Emmet county: B. O. Wolden.

The flora of Mitchell county: Mrs. Flora May Tuttle.

A naturalist's glimpse of the Limberlost: MRS. FLORA MAY TUTTLE.

Seed formation in Utricularia: ROBERT B. WYLIE and ALICE E. YOCOM.

Notes on new or rare Iowa trees: B. SHIMEK.

A discussion of certain rare species, chiefly of the genera *Quercus*, *Fraxinus* and *Carya*.

The genus Ceanothus in Iowa: B. SHIMEK.

A discussion of the species and varieties found in Iowa.

Rosa pratincola Greene in Iowa: MISS EVELYN ENSIGN.

A taxonomic and ecological discussion of the common prairie rose.

The fern flora of Nebraska: T. J. FITZPATRICK.

Gives a short sketch of the seven physiographic regions of Nebraska, noting the ferns found in each; eight reasons are formulated to account for the paucity of ferns in the state. The annotated list is based upon the material in the herbarium of the University of Nebraska.

Supplemental list of plants from southeastern Alaska: J. P. ANDERSON.

Measurements of wood fiber: HENRY S. CONARD and WILBUR A. THOMAS.

Check-list of the plants of Grinnell: HENRY S. CONARD and FRANK E. A. THONE.

Study of a section of the Oregon coast flora: MORTON E. PECK.

Hybridization in Iris: MISS M. LOUISE SAWYER.

Studies upon the absorption and germination of wheat treated with formaldehyde. (1) Dipping method: A. L. BAKKE and H. H. PLAGGE.

Chemistry

A chemical examination of some dolomites: NICHOLAS KNIGHT.

The analysis of a number of dolomites of the same geological formation, but from quite widely different localities, was made to compare the chemical composition. A specimen from Mount Vernon, Iowa, was chosen, and another from Lockport, New York, both belonging to the Niagara period of the Silurian age, and their composition was quite identical; also, another specimen from Westchester county, New York, resembling marble in physical aspects, belonging to the Cambro-Silurian, proved quite a typical dolomite, similar in composition to the others investigated.

The electromotive force and free energy of dilution of aqueous solutions of sodium bromide: H. B. HART and J. N. PEARCE.

Geology

Meteor mountain: DAVID H. BOOT.

The Aftonian gravels near Afton Junction—are they interglacial? GEORGE F. KAY.

Some large bowlders in Kansan drift in southern Iowa: GEORGE F. KAY.

A problem in municipal waterworks for a small city: JOHN L. TILTON.

New features with reference to the Thurman-Wilson fault: JOHN L. TILTON.

Note on conditions at the head of flood plains: JOHN L. TILTON.

Exhibition of pictures of the tornado which passed through Eastern Nebraska, April 6, 1919: JOHN L. TILTON.

The relation of the Satsop flora to the youngest known mountain range in North America: RALPH W. CHANEY.

Leaching, a factor in determining the age of glacial gravels: WALTER H. SCHOEWE.

The history of Boyer valley: JAMES H. LEES.

The Iowan-Wisconsin drift border: E. J. CABLE.

The deep well at Laurens and its interpretation: E. J. CABLE.

The effect of rivers on the location of Iowa cities: MISS ALISON E. AITCHISON.

An illustration of the wedge-work of roots: A. O. THOMAS.

A large granite boulder near Nashua, Iowa, is split by an elm tree fifty feet high growing in the cleft.

The ascent of Mt. Misery on the Island of St. Kitts, British West Indies: A. O. THOMAS.

Mt. Misery is an extinct, or at least a dormant, volcano. A day's stop at Basseterre permitted the writer and two other members of the University Barbadoes-Antigua expedition to climb the mountain. The setting of the mountain, the tree fern forest on its flanks, the crater, and the view from the summit are described.

A Herpetocrinus from the Silurian of Iowa: A. O. THOMAS.

Some remains of this remarkable genus of crinoids were recently collected at Monticello. Its structure, habits and geographic distribution in the Silurian rocks are discussed. This is believed to be the first reported occurrence of this crinoid from the Iowa Silurian.

The Independence shale near Brandon, Iowa: A. O. THOMAS.

Outcrops of this formation are rare. At two or three localities near Brandon, twelve to fifteen miles southwest of Calvin's original exposure,

occurs a bed several feet thick. It contains an abundance of the typical fossils.

Iowa's geological centenary: CHARLES KEYES.

That modern geology in America had its beginnings in Iowa appears to be not generally known. Before Thomas Nuttall's famous trip down the Mississippi River in 1809, and his extensive application of William Smith's principles of determining the relative age of rock terranes by means of their contained fossils American geology was distinctly Wernerian in aspect. The eminent German never had a stronger advocate than William McClure, president for many years of the American Philosophical Society, of Philadelphia. It was Iowa's particular mission to be the ground where the fossils were collected and the materials first critically compared with the organic remains of the mountain limestones of Derbyshire, England. There are a score or more important episodes in the history of American geology which first found light of day in Iowa.

Tertiary gravels of northern Utah: CHARLES KEYES.

The recent tracing of the Bozeman gravels of Montana over the crest of the Rockies into southern Idaho suggests their unbroken continuity farther to the south. They there seem to connect with the gravel beds exposed in the Red Rock Pass region and beyond in northern Utah, which have long remained a puzzle to all who have worked in that field. The fact that the gravels at the Pass appear to have been moving southward at the time of their deposition also has an important bearing upon the genesis and duration of the old Bonneville lake.

Louisian vs. Mississippian as a periodic title: CHARLES KEYES.

If we are to retain a geographic designation for the Early Carbonic rocks of America there is a valid term which has by a full decade priority over Mississippian. This is St. Louis, or, as we would call it in these enlightened days, Louisian. It is a name that was originally proposed for what was supposed to be the exact section covered by the Mountain Limestone as displayed in Derbyshire, England. Subsequent severe restriction of the name St. Louis to a single terrane and its wide use in this sense do not militate in the least against its first employment. A more satisfactory usage of the term Mississippian is as a serial title for a provincial succession, as recently proposed.

Possible errors in Pleistocene field-observations: B. SHIMEK.

A discussion of the value of root-tubules, calcareous content, fossils, etc., in determining the age of loess deposits; also certain dangers in the use of physiographic criteria in determining the age of Pleistocene deposits.

Helicina occulta Say: B. SHIMEK.

Additional notes on the distribution of this species. Both recent and fossil forms are discussed.

Physics and Psychology

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JAMES H. LEES,
Secretary

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SIGMA XI AND THE FUTURE[1]

Members of Sigma Xi, Initiates and Guests:

For many years it has been the custom in our chapter upon the occasion which each year corresponds to this, for the president of the chapter to read an address in order to explain the more clearly to those whom we are honored to receive into membership the spirit of Sigma Xi. In some instances this address has taken the form of a description of a piece of research; in others a general statement of the function of Sigma Xi in furthering the cause of research. Much as I should like to be relieved of the honor of addressing you this evening, I feel that it would ill become me to change so time-honored a custom. And accordingly I beg your indulgence while I discuss some of the problems and the obligations before Sigma Xi, at least as I see them. This subject seems to me to be particularly appropriate just now because of the uncertainty of the conditions to be met in the new era, into which, we are all agreed, we are entering.

First, however, permit me to review briefly the history of Sigma Xi—this with the double purpose of acquainting our new members with the origin and development of the society which, to-night, they are joining, and of furnishing a foundation upon which logically to discuss the problems before us. For we must build the future upon the experience of the past.

To those of us whose educational home is Cornell, Sigma Xi has a peculiar significance, for it was here, thirty-three years ago, namely in 1886, that the society was founded, and it is from here that the society has spread, until now chapters are found in nearly every large institution of learning in the country. How was it that these young men, in this

[1] Presidential address before the Alpha (Cornell) Chapter of Sigma Xi, May 17, 1919, upon the occasion of the initiation of new members.

young university, at that time less than a score of years old, came to found a society which has exerted such a marked influence upon the progress of science? Perhaps they had absorbed something of the spirit of the place, a spirit of faith in the future, which, in the early days made Cornell a leader in so many lines of university activities, and by the very originality and boldness of the idea which they conceived foreshadowed that for which the society now stands.

We shall probably never have a complete account of the events in the spring, summer and autumn of 1886 that led to the formal establishment of the society. The existing records are very meager; many of them undated; and what has been written is largely the result of piecemeal compilation. I can, however, give you a glimpse of those early days, so full of interest and inspiration to us of the present generation as we look backward, by letting one of the founders speak for himself—Mr. W. H. Riley, of the class of '86, and a charter member of the Alpha chapter:

> You asked me to tell you about Sigma Xi. Well it has been so long ago that I have forgotten most of the details but I will tell you as much as I can remember. During my last three years in Cornell I ate with a bunch of boys who were mostly Arts students and most of them very good students. Every spring some of the boys won their Phi Beta keys and of course these were the occasions of congratulation and discussion. In the spring of 1886 two of my best friends received their keys, which started me to thinking that there should be some honors bestowed on the scientific students who had done good work. I discussed the question with W. A. Day, my chum, an engineering student, and we grew very enthusiastic over it. At this time there was an instructor in Sibley College, Mr. Frank Van Vleck, with whom we were very intimate. He was a graduate of Stevens Institute and was brought to Cornell by Dr. Thurston when he came from Stevens. We mentioned the subject to Mr. Van Vleck one evening while seated under the trees on the corner of Factory (now Stewart) Avenue and State Street, in front of our boarding house; he was much taken with the scheme and thought it should be worked up immediately. This was about the first of May. From that time until commencement we often held meetings, the three of us, under the trees or walking down town. Mr. Van Vleck consulted the faculty and Mr. Day and myself the students. Everybody thought it was a good scheme, but as graduation was so near we could not get them aroused. The week before commencement we had a meeting and decided to stay awhile after the close of college and work the matter up, but I was called home directly after commencement. Mr. Day and Van Vleck stayed until they had everything planned out. We had some correspondence during the summer but it has all been mislaid. Mr. Van Vleck presented his scheme in the fall of 1886 and a society was formed.

The idea then originated with these three men: Messrs. Riley and Day, of the class of '86, and Mr. Van Vleck, an instructor in Sibley College and a graduate of Stevens Institute of the class of '84. With them there were associated in perfecting plans in the autumn of 1886, six other young men: three of them graduates of Rensselaer Polytechnic Institute, of the class of '86, then students at Cornell, and one each from the Cornell classes of '86, '87 and '88—young men, under twenty-four, all of them. They planned a society whose watchword should be "Friendship"; and they joined hands "in forming a brotherhood in science and engineering which should promote and encourage by strong personal attachments of friendship the highest and truest advances in the scientific field" and which should "lend aid and encouragement to those newer brothers, who, likewise laboring in the same spheres, were aspiring to honored positions." They agreed to "lend their efforts to the establishment of an organization to be publicly known as the 'Society of the Sigma Xi.'"

About the same time the late Professor Henry Shaler Williams, then professor of geology at Cornell, realizing the need of an honorary society for scientific students, similar to Phi Beta Kappa, drew up a plan for a society to be known as "The Society of Modern Scientists," the object of which should be to recognize by some mark of honor, "those who exhibit special ability in investigating, understanding and interpreting the facts of nature in the various branches of modern science, in order to encourage high attainments among

the future students of Cornell University and of other kindred institutions."

These two movements, independently and stimultaneously started, soon came into contact, and finding so much in common, at once joined hands, keeping the name of the organization already perfected by the younger men, but extending its scope and influence according to the council and advice of the older man. Shortly after, apparently in the winter of 1887, four faculty members and five graduate students were invited to become members of the new organization. In the spring of 1887 is recorded the establishment of two chapters, one at Union College and one at Rensselaer. For some reason comparatively little progress was made in further extending the movement although six more chapters were authorized by the parent chapter and plans for the organization of still others were made. None of these, however, were established, and after many discouragements some of the leaders became disheartened, thinking that after all the time was not ripe for such a movement. But finally a charter was voted to Kansas in 1889. This was the status of the society until 1893, when a convention of the four chapters was held in Ithaca, at the call of the parent chapter and a national organization was formed. In 1895 a charter was granted for the establishment of a chapter at Yale, and from that time on there has been a steady increase in the chapter roll. At present there are thirty chapters, in nineteen different states, with a total membership of nearly 12,000 of whom about 2,500 are resident in the universities where chapters are located, and are therefore classed as *active* members, while the remainder, not being directly resident in the chapter, are called alumni, or non-active members.

During its third of a century of existence the motto of the society has been "Companions in Zealous Research"; its object, to encourage "original investigations in science, pure and applied"; and it has sought to accomplish this purpose, in the main, by three different classes of activities: first, by holding meetings for the discussion of scientific subjects and by printing such scientific material as may seem desirable; second, by establishing fraternal relations among investigators in scientific centers; and third, by granting the privilege of membership to such students as, during their college course, have given promise of future achievements in the field of science. While the activities of the several chapters have been varied to suit local conditions, it has been their common object to emphasize that which all investigators have in common: that indefinable something which goes by a variety of names; which "can be felt but not itself investigated"; that something within him which the investigator satisfies by seeking out the truths of nature and then making them known to his fellow men, with a faith, usually unexpressed, that some day these same truths would make the world better, though perhaps a busier, place to live in.

Such then has been the origin, development and activities of the society to which we belong. It is to be hoped that we will carry with us into the future these same ideals, and perhaps many of these same activities, which have made so much for the success of the society in the past. But without doubt the world is now entering a new era, a new order of things, in which every institution, whether political, economic, educational or scientific, will face new conditions, new obligations, and new opportunities. Just as the scientist, in his field, is a pioneer, so he should be among the first, if not the leader, in making his field ready for this new order of things. We may then well ask: Can Sigma Xi adequately discharge her responsibilities in this new era without an extension, perhaps a radical extension, of her former activities and influence? The very form of the question indicates a negative answer.

Before discussing these extensions, I should like to point out that the sphere of influence of Sigma Xi has, up to now, been confined almost exclusively to university circles. With the exception of that at Washington, the chapters are all located at universities. This is not so significant as is the fact that only those who are members of the university community can be *active* members. The result is that over

three quarters of those who have been elected are alumni, or non-active members, and have no connection with any chapter, or indeed with the society. And another point is that the activities of the society have been largely internal, in the same sense, roughly speaking, that a fraternity exists for the benefit of those who are members of it, and whatever outside influence it exerts is of a passive, rather than an active kind. The young investigator may aspire to the honor of an election to membership, but there is at least a gain of truth in the definition that "an honor is that which one does not appreciate *after* one gets it."

Broadly speaking we may classify the fields in which Sigma Xi may extend its influence as local, national and—it may be a dream, but I am going to add—international.

The local problems confronting each chapter are more or less peculiar to the chapter, and in discussing these I can only speak of conditions existing here at Cornell. How can we, right here at home, lend still further encouragement to "original investigations in science, pure and applied"?

One of the most important problems discussed by President Schurman in his recent annual report is that of raising the standard of scholarship in the university. The very fact that the president has seen fit to raise this question in an official report indicates how serious the situation seems to him. For solving this difficult problem various means have been suggested, such as the establishment of scholarships, prizes, honor courses and the like. Each of these will doubtless be effective, but no one of them can be considered a cure-all. Any solution must be based upon the fundamental object of a university course, which, I take it, is *not* to make of a student in four years a walking encyclopedia, but rather to teach him a *few* facts, and in four years, to inspire in him such habits of study and scholarship as will make him a student for the rest of his life, whether his field be philosophy or engineering, so that his *real* studies will begin, not end, on commencement day. For, that man is successful in the practise of his profession who, in his college course or elsewhere, has gained confidence in his ability to undertake and accomplish successfully things which are new to him and which very likely have never been done before. The man who lacks this confidence, one might even say habit, of independent thinking, is likely to become a mere clerk or mechanic and to stay at the bottom of the ladder.

Now, you may teach facts and the relation of one group of facts to another—all that part of knowledge which we may classify as encyclopedic—but, try as you may, you can not teach by aid of any sort of artificial stimuli, life-long habits of study and of independent thought. These can come only *by inspiration and example,* for both of which the student must look, indeed it is his right to look, to the faculty, if he is to get full value from the four years of his time which he spends here. Or, looking at the university as an economic unit in society, *we can not expect to turn out a productive student body from a comparatively non-productive faculty,* non-productive not so much because of lack of interest in scholarship and research as because of lack of opportunity.

One of the properties of matter is that which we call inertia, by virtue of which a body at rest remains at rest unless acted on by some outside force, or if in motion remains in motion unless brought to rest by some outside force. The application of this principle extends, at least in a qualitative way, far outside the realm of material things. In our ordinary, every-day life we call it habit. It takes force, of one kind or another to make habits and it certainly takes force to break them.

It was probably in unconscious recognition of this principle that the remark was made some time ago, that while it might be true that students would study if interested, it was also true that in order to become interested they must be made to study. Because of the inertia of the human intellect, this probably applies, more or less, to all of us, *to the faculty* as well as to the students. If therefore, we would have a scholarly, productive faculty, by means of which to turn out a productive

student body, it follows that we must first *require* productive scholarship of the faculty *as a part of its duty to the university.* The interest in original work, thus aroused by compulsion if you will, will be self-sustaining and will accomplish the double purpose of setting an example to the students, by means of which, I firmly believe, many of our problems of undergraduate teaching will be solved, and of accomplishing that other prime function of any real modern university: the adding to the sum-total of knowledge.

Now, I would not presume for a moment, to suggest what alterations in the educational and the financial policies of the university may be necessary to bring about this much-to-be-desired condition, nor would I attempt to outline. what part Sigma Xi may play in ensuring an increased recognition of the value to the student body, to the faculty, to the country, of more original investigations "in science, pure and applied." But what I do wish to point out is that here is a problem, right in our midst, which touches the very foundations upon which Sigma Xi is built, and to ask whether it is not our duty, officially as a society, to lend our organization, our ideals and our traditions "to encourage higher attainments among the future students of Cornell University." If we really believe in that for which the society stands, I regard it our duty to take an active part in the solution of this problem.

Coming now to an extension of the activities of the national organization, may I mention briefly two items already under consideration.

First, an extension of the chapter roll: For many years the society has exercised the greatest care in the admission of new chapters—this, without doubt, being due to the early experiences above mentioned, of the parent chapter. It has been felt that any institution, before being granted a charter, should have demonstrated beyond any doubt, its ability to maintain a high standard of scientific work. Now, however, with the increasing strength and stability of the society, we feel that, even though there may be a small risk involved, it is safe to go a step farther by granting charters to such smaller institutions as may have given distinct promise of creditable research activity. We may therefore expect a considerable increase in the chapter roll in the next few years.

Second, Sigma Xi fellowships: It has always been a matter of regret that neither the chapters nor the national society could directly engage in research. However, under the able leadership of our national president, Professor Stieglitz, of the University of Chicago, a movement has been started to enlist the support of the 12,000 members of the society, by asking for annual contributions from each member of say one or two dollars, for the establishment of at least two fellowships (more if possible) of a value of $1,500 or $2,000 each, one in the physical sciences and one in the biological sciences; these to be awarded each year on some sort of a competitive basis. The value of these fellowships would lie not so much in the satisfaction that we would feel in actually engaging in research, as in increasing the stability of the national organization by furnishing some tangible thing around which would center a common interest. At present the problems of the several chapters are so largely local and so little national that there is need for something to bring them closer together.

This movement at once suggests an obvious, though perhaps a radical change in our past procedure. When Sigma Xi was founded it was perfectly natural that its activities should be confined almost exclusively to university centers. Then the university *was* the home of pure science, and to a large extent of applied science. But now, due in part to the increasing economic importance of scientific work, and in part to the extent to which teaching duties are allowed to encroach on the time of the professor, conditions have radically changed. You have only to glance over the papers presented at the meetings of the scientific societies to realize that more and more research in pure science is coming as a by-product from the ever increasing number of governmental and industrial re-

search laboratories, on such a scale as to overshadow the output of the universities. And as for applied science, I need only mention a few recent developments, from one field, namely physics; such as: the tungsten lamp, which is worth annually to the country a sum expressed in hundreds of millions; the thermionin X-ray tube, which in addition to revolutionizing some phases of medical practise, has given to the investigator in pure science an instrument of research the value of which can hardly be overestimated; the wireless telephone, the beginnings of which as a factor in our economic life we have not yet begun to appreciate; multiplex telegraphy and telephony, by which many messages, part telephone and part telegraph, may be sent simultaneously over the same pair of wires with a consequent reduction in the cost of operation; improvements in the methods of maintaining, measuring and recording high temperatures, so important in many industrial processes; the high potential kenotron, a device which will probably clear Pittsburgh and every other city of its cloud of black smoke; a clearer understanding of the requirements of the human eye in the matter of artificial illumination; these, and countless other devices, all coming from outside of universities, may well raise the question as to whether we can *now* say that the university is the home of science, either pure or applied. If the university *is* the home of science, then it must be said that science is a large part of the time away from home, and even when at home occupies only a corner of the attic. If the universities would keep science *at* home they must provide the main suite on the first floor.

In other words, looking at it from whatever standpoint you please, it is certainly true that pure science as well as applied science has outgrown the universities. Unless therefore we wish to apply a purely arbitrary definition to "original investigations in science" we must extend the active influence of Sigma Xi beyond university centers. The fact that the investigator in applied science is given equal recognition with the investigator in pure science at once indicates that the society raises no questions as to what use shall be made of the results of the investigation. It should likewise make no difference where the work is performed, whether in a government laboratory, an industrial laboratory or a university laboratory, so long only as the investigator is sincerely looking for "the truth."

So far as formalities are concerned, this extension can be very simply made, for it is only necessary to make active members the ten thousand (approximately) non-active members, who collectively represent practically every industry, and every educational institution in the country. We would then have available adequate machinery for spreading the society's ideals so as to cover the whole field of science, and not simply that portion of it which is found in universities. To do this seems to me not simply a duty which we owe to our alumni members, but an opportunity to extend our sphere of influence—an opportunity, the neglect of which would be an unpardonable waste of our "natural resources."

But it might be asked: what can we do with 12,000 members scattered throughout the country which is not being done by the several engineering and scientific societies. There is this difference: These, in the main are at work advancing knowledge in their respective fields. Sigma Xi, however, includes all science; and could undertake common problems such as, for example, a campaign to increase the popular appreciation of the value of scientific research. Such a campaign would have to be carried on in a very dignified, judicious way, but I believe there is need for it. It is one way to express the contribution of Sigma Xi up to the present by saying that the society has attempted to make science appreciated by scientists. The next logical step is to make science appreciated by those who are *not* scientists: to correct the popular impression that it is only necessary for some inventor to conceive a new idea, and behold, a wonderful new invention, such as the wireless telephone, springs full grown as from the head of Zeus; to point out the tireless research be-

hind such a device as this and that it is the people of the country in the long run who profit by the work of the investigator; and that such work is worthy of more stable support than the chance generosity of some multi-millionaire. From an economic standpoint scientific research is a well-established business, not the mere whim of a few individuals; a business involving perhaps a long-term investment but which nevertheless is just as worthy of support, and economically just as important, as is the postoffice department or the railroads, differing from these only in the fact that these supply the present generation while scientific research, like the public schools, is for the next.

Whether we shall see government support of research in pure science depends, I believe, only on whether the scientific societies of the country, of which Sigma Xi is as representative and potentially as influential as any, can agree upon and present to Congress a concrete statement of the responsibilities of the federal government in this matter as well as a workable plan for administering such support. In a democratic country it seems impossible that ever again should it be left to accidental philanthropy to provide funds for building the very foundations of economic and industrial progress.

Of the possibilities of making the influence of Sigma Xi international, little need be said except in amplification of the statement that even now the matter is under informal consideration and will probably come before the society for formal action some time within the next two years, in response to inquiries from two foreign countries, England and Norway. The sentiment of the society, so far as voiced, is in favor of such an extension, and there seems to be nothing either in our constitution or our traditions which prevents. May we not look forward therefore with much hope to an international fraternity of scientific workers, the influence of which, even though sentimental rather than scientific, will serve as one additional bond to tie together that which we all hope to see some day: a great family of nations.

F. K. RICHTMYER
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ZOOLOGICAL AIMS AND OPPORTUNITIES

IN its recent numbers SCIENCE has printed two addresses made before the Baltimore meeting of the American Association for the Advancement of Science last winter, both of which deal with the same general subject; the aims and purposes which in the present critical period of the world's history should guide or influence zoological and botanical work, and the opportunities offered and responsibilities imposed by the present conditions on those engaged in such work.

Both of the addresses contain much that is interesting and inspiring and make suggestions that are well worth trying out, but neither of the two speakers seems to have felt it necessary to extend his survey of the field beyond the two subjects of teaching and research, though of course including under the latter heading investigation for practical and economic purposes as well as for the increase of knowledge without immediate prospect of its application. This limited conception of their proper aims and obligations is unfortunately held by a large proportion of scientific workers, probably more often because it falls in with their inclinations and convenience than because of any conviction of its sufficiency; it may have answered well enough in the earlier stages of the development of science and may still do so in some departments of it, but it is now very far from sufficient in the case of zoology, botany, ecology, forestry and other allied branches. The rapid economic expansion of the present time is making demands on natural resources to an extent that was never before approached, and improved and quicker means of transportation are extending the resulting destructive effects to every part of the world. Only prompt and scientifically directed effort can save from complete and permanent destruction and disappearance a large part, and perhaps much of the most interesting part, of the subject matter with which these sciences deal. It is only those with more or less scientific knowledge of animals and plants who can see in advance the need of protective or remedial measures and

can direct and carry them out with any hope of success. It therefore seems as if the speakers themselves missed an important opportunity and failed in an even more important responsibility in addressing such audiences as were gathered in Baltimore, and the vastly larger circle that is reached when the addresses are published, without a word, and apparently even without a thought, of what might and ought to be done by scientific men for the preservation from extinction or destruction of the hundreds of interesting species of animals and plants and the many places of unusual scientific interest that are being sacrificed for the selfish interests of a few, or even merely by neglect and indifference, with resulting advantage to nobody.

Obstruction of important conservation measures until everything that they were designed to protect has been made away with, and laws and efforts that fail of their purpose because unwisely directed or inefficiently carried out, would not be so frequent were it not for the easy-going indifference and irresponsibility of those who are the only ones who can fully realize the needs and urgency of the situation, and who should therefore feel it a duty to make others understand also. We may be shocked and indignant at the vandalism of the Huns of ancient and modern times in respect to works of art and the results of human industry, but we ourselves act no better toward natural objects of unique interest, value and beauty, and more intelligent generations in the future who will find themselves deprived of much that it was our duty to preserve for them will no doubt regard us with the same kind of feeling as we look upon the despoilers of Belgium, France and Serbia. Yet there are few scientific men who concern themselves with such matters to any extent greater than occasional expressions of regret; sentiments which would seem more sincere if accompanied by some effort to assist the small minority who do take up the burden of active work to bring about a better order of things. One often can not help wondering whether zoologists, botanists and foresters do not as a class care less about the living things they occupy themselves with than most other people. If they are not to be open to such an accusation, now that the war is over and a period of economic expansion begun that will be even more destructive to the small part of the world that still remains in what we call for lack of a better term its natural state, there should be no delay in starting more extensive and efficient cooperative work on the part of scientific men and societies for the preservation of those natural objects of scientific interest and those species of animals and plants that are most immediately threatened with extinction or annihilation.

Very few scientific societies or institutions have any committee or representative with the duty of engaging in such work or cooperating with others in it, or of watching out that those to whom such work is intrusted by the government or by societies supported by private subscription are doing their work as diligently and as effectively as the means available will permit. Many more should have them than is now the case. The need is so urgent and immediate that a share of the responsibility now extends to many associations and institutions whose main aims and purposes lie so much in other directions that under ordinary conditions they could justly claim that to devote means and efforts for such purposes would be outside of their proper duties. But emergencies impose new obligations, and however unwelcome they may be, if they are shirked the result can only be discredit and regret after it is too late for any remedy.

No one should delude himself with the idea that because there are in this country certain societies for the protection of birds and animals or because the federal government has at length begun to take a small part in it, that there is nothing more to be done by others. One might suppose that after over twenty years of agitation of the matter, and after abundant evidence of much interest on the part of the general public, that our native North American birds would now be receiving proper protection, but at the present time one of the most discreditable and inexcusable acts of

systematic vandalism that has ever occurred on this continent is being carried out at the public expense by the Alaskan territorial government, which in 1917 placed a bounty on eagles. In less than two years about five thousand six hundred of these birds, which must be of a large percentage of the entire number inhabiting North America, have been killed for fifty cents each, and the slaughter is still going on. From what is known of the habits of the bald eagle it can not be doubted that reports of its depredations have been grossly exaggerated, and that an impartial scientific investigation would prove that much persecution that it is suffering is both unnecessary and unjustified.

Places in North America outside of Alaska and some of the neighboring British territories where eagles can still safely breed are now very few; they rarely successfully raise more than one or two young in one brood, and the growth of the young birds is slow, so that the same pair can not raise young every year. Eagles are naturally very long-lived birds and a large part of those now living were raised many years ago when conditions for breeding were more favorable, and at best the birds would not be able to maintain even the present small numbers still existing under the conditions now prevailing. It is evident that such destruction as that which is going on in the only part of the continent where these birds are still numerous has already advanced a long way toward adding our national emblem to the list containing the Labrador duck, the passenger pigeon, the whooping crane, the trumpeter swan, the Carolina paroquet and others that have now disappeared forever. With more active interest on the part of those with scientific knowledge, the passenger pigeon might not have become extinct, since it might have been preserved by the simple expedient of protecting its breeding places; the few remaining individuals of the heath hen would not have been allowed to remain where a single forest fire could wipe them practically all out; the small remaining colonies of the California sea elephant found a few years ago might not have been left without protection, and the golden plover, which is on the verge of extinction, would not be especially excepted from protection by the present federal migratory bird law. With more scientific and intelligent judgment applied to such matters the Klamath lakes, which are among the most important remaining breeding places for wild fowl in the United States, would not now be being drained; and many other mistakes or worse than mistakes might have been avoided, or in some cases might even still be corrected.

The particular purpose of this communication is however to call attention to one phase of protective work which is very important for science, and in which scientific men and societies must especially interest themselves if it is to be taken up at all, for the general public can not be expected to appreciate its importance. This is the protection of what remains of the unique and peculiar forms of animal and plant life that inhabit many of the remote islands and isolated island groups in various parts of the world. These contain many species of birds, animals and plants peculiar to themselves, and represented, on account of the small area they inhabit, only by few individuals. They are thus very likely to disappear, either through changes caused by, or direct destruction by man or by noxious animals, as the mongoose, domestic cats and rats introduced by man. Hundreds of interesting island species, including birds, reptiles, insects, mollusks and members of other groups, have already become totally extinct through human agency, and many of the remaining ones are immediately threatened with the same fate. On such islands there usually were, and on many there still remain, forest tracts containing plants found nowhere else and presenting ecological conditions entirely unique and therefore of great scientific interest. If they could be preserved, which is desirable for their own sake, they would serve as reservations for preserving the native animals also. This would in many cases not be an expensive undertaking, as it is chiefly in land unfavorable in character or situation for agricultural purposes that such forests have been allowed to remain, and it is probable that

in some cases the local governments could be induced to set them aside as reservations if the reasons for it were made clear.

Such islands as those here referred to, do not however have a sufficient proportion of inhabitants with scientific interests and with the means or enterprise to take any effective steps toward preserving their native plants or animals, nor do they appreciate their unique character, or fully realize that the things they see about them all the time are found nowhere else in the world. The initiative, encouragement, and no doubt some money (it would in many cases not take a great deal) must come from outside. This is not a matter of local interest only, it concerns nature students, zoologists, botanists and foresters throughout the world, particularly those interested in these sciences from an ecological point of view.

There never has been a time when international jealousies and mistrust and obstinate conservatism have so nearly disappeared from among the nations holding colonial possessions as they have to-day. The international cooperation of scientific societies and of the local and general governments necessary to carry on such work is not nearly so far outside the range of probability now as it would have seemed a few years ago. It seems a favorable time for some of our larger and more influential scientific associations and institutions to make a beginning by the appointment of a committee to communicate with others that might be interested, and discover what support and encouragement such a movement could hope for. The need is urgent, every year's delay will increase the difficulty and greatly diminish the results that it will be possible to achieve.

WILLARD G. VAN NAME

SCIENTIFIC EVENTS

THE ANTHROPOLOGICAL SOCIETY OF PHILADELPHIA

AN article in the *Pennsylvania Gazette* reports that for the past ten years a small group of men, interested in some aspects of anthropology, have held meetings (informal at first, before 1914) for the interchange of ideas and the stimulation of interest. The nucleus of this group was certain members of the faculty of the University of Pennsylvania and of the staff of the university museum, whose work lay in this field. The remainder were students and "laymen" who had some interest in anthropological studies, and who served to leaven the whole and widen the usefulness of associating together.

In the beginning no attempt was made to keep any definite object in view nor to expect anything more than that sociability would grow out of these gatherings. But when a man came home, after a bit of interesting field-work, one of the first things he did was to look up the next meeting of his friends and co-workers, to talk over his trip and perhaps to display photographs and specimens. In this way there arose evening meetings devoted to particular topics, with "speakers," meetings which were informal, but which tended toward a definite purpose. The café in which these friends usually met gradually became a sort of headquarters for the entertainment of anthropologists, visiting field-workers and members of societies from other cities.

In March, 1914, a serious attempt was made to increase the usefulness of these informal gatherings by adopting a regular date and place of meeting. The first step in this direction was to elect a president, a secretary-treasurer and an executive committee. Thus formed, and under the name of The Anthropological Society of Philadelphia, those interested began to hold regular meetings and to hear prepared papers and discussions once each month during the winter. The social character of the meetings was kept as much as possible and all formality was avoided, just sufficient, indeed, to preserve a natural cohesion of interest and companionship.

During the past three years funds have been appropriated by the provost through Dean Ames, of the university to pay the expenses of non-resident speakers to address the students of the department of anthropology; permission was obtained, through the efforts of Professor Frank G. Speach, of the department,

to combine the meetings of students and members of the society for mutual benefit. This arrangement has enabled the society to entertain some of the foremost anthropologists of the country, keeping the members in touch with the important work being done in other university centers; and making this body the center of things anthropological in Philadelphia.

At the first formal meeting of the society in 1914, Professor W. Max Müller, the Egyptologist, was elected president for the current four years. The president for the current year is Professor Walter Woodburn Hyde, of the department of Greek. Professor Speck, of the department of anthropology, has been an active member of the executive committee from the beginning, contributing largely to the success of the society.

Among the outside speakers who addressed the society in the past two seasons were:

Dr. Robert H. Lowie, curator of ethnology, American Museum of Natural History, New York. (Two papers.)

Dr. Alexander A. Goldenweiser, Columbia University. (Two papers.)

Professor Franz Boas, head of the department of anthropology, Columbia University.

Professor Alfred L. Kroeber, head of the department of anthropology, University of California.

Professor Spencer Trotter, department of biology, Swarthmore College.

Professor Phineas W. Whiting, department of biology, Franklin and Marshall College.

Honorable Gifford Pinchot, formerly chief forester of the U. S.

THE BRITISH NATIONAL PHYSICAL LABORATORY

THE custom which held before the war of inviting a number of visitors to the National Physical Laboratory in June has had to be suspended during the last four years, but it was revived on June 24 on the occasion of the annual inspection by the general board, the chairman of which, Sir J. J. Thomson, O.M., received the guests.

The London *Times* states that those who had not seen the laboratory since the war could scarcely recognize the place, so numerous are the extensions that have been made, and yet the accommodation is even now inadequate for the work that has to be done. Perhaps the most conspicuous of the additions is a new aeronautics building which, among other things, is to house a huge wind channel, 14 feet across, for the testing of aircraft models.

Arrangements had been made by the director, Sir Richard Glazebrook, who is retiring in September, for conducting the visitors over the laboratory, and numerous demonstrations illustrating the work that is being carried on in the various departments had been arranged for their edification. Thus, in the metallurgy department the new rolling mill was shown in operation rolling high-tensile aluminium alloys down to very thin sheets suitable for covering the wings of aeroplanes in place of fabric. In the existing wind channels of the aeronautics department experiments were being conducted on the balancing of airship rudders, the mutual interference of airscrew and body and the flow of air in the neighborhood of the airscrew, the spinning of aeroplanes, and other points. The William Froude National Tank was being employed for the testing of seaplane floats, some of the experiments relating to the resistance, running angle and longitudinal stability of the float while planing on the water, and others to the impact of a seaplane when alighting on water. In the metrology department various munitions gauges, in the supply of which the laboratory did such good work during the war, were on view, and there was a minimeter capable of registering differences of one millionth of an inch. An electrical device for indicating at a distance the depth of petrol in the tanks of an aeroplane was to be seen, and in the department of electrotechnics there was the Paterson-Walsh electrical apparatus which was used as part of the London air defenses for ascertaining the height of hostile aircraft, while experiments with wireless telegraphy were conducted in a hut in the meadow. The engineering department and the optics division of the physics department were also open among other sections.

THE NEW BRITISH ANTARCTIC EXPEDITION

MR. J. L. COPE, who is organizing and will lead the British Imperial Antarctic Expedi-

tion which is to sail next June, and will be absent about six years, is shortly leaving England for Canada to make arrangements for the bringing to this country for the necessary fitting up of the *Terra Nova,* which has been secured for the venture.

Mr. Cope is at present engaged in appointing the personnel of the expedition. Professor R. C. Mossman, who has been appointed chief of the scientific staff, was meteorologist to the Scott Antarctic Expedition; Mr. A. H. Larkman, who sailed in the *Terra Nova* as chief engineer with the Shackleton Expedition, has signed on with the British Imperial in the same capacity; and Mr. T. H. R. Hooke, R.A.F., who was also with the Shackleton Expedition, has been appointed chief of the wireless staff. Captain Hurley, who during the war was one of the official photographers to the Australian forces and who accompanied the Mawson Expedition as photographer, will go with Mr. Cope as photographer. A cable has been received by Mr. Cope from Mr. Ernest Joyce, who was a member of the Scott and Shackleton expeditions. It is probable that Mr. Joyce will accompany the present expedition, and in the meanwhile he is in charge of the organization in Australia. Lieutenant E. Healy, late Dublin Fusiliers, has been appointed a member of the shore party, which will leave the *Terra Nova* when the vessel becomes fast in the ice, and will explore the district to the south of the great ice barrier.

It is the intention of Mr. Cope to take an aeroplane on board the *Terra Nova* and make a flight to the South Pole. Already two firms of aeroplane makers have offered to supply the expedition with a machine free of cost. Generous support is being given the expedition by commercial firms.

DISTINGUISHED SERVICE MEDALS

THE distinguished service medal has been awarded as follows: Colonel William H. Welch, United States Army. For exceptionally meritorious and conspicuous service. From his rich experience in scientific medicine, sanitation, public health and medical education he helped materially in guiding the medical profession both in and out of the Army safely through many difficulties of war. Colonel Victor C. Vaughan, United States Army. For exceptionally meritorious and conspicuous service. During his service in the office of the surgeon-general his contributions of advice and information have been of great value to the Army in connection with the control of communicable diseases. During the recent epidemic of influenza, in particular, his work was of extreme value. Lieutenant-Colonel Richard P. Strong, Medical Corps, United States Army. For exceptionally meritorious and distinguished services. Possessed of the highest professional qualification and actuated by zealous devotion to duty, he has rendered service of inestimable value to the American Expeditionary Forces, notably as president of a board appointed to investigate the cause of trench fever, a disease which has caused serious losses to the effectives of the allied armies. The scientific research of this board under his skilful direction led to the discovery of the means by which trench fever is transmitted and in the establishment of effective measures for its prevention.

SCIENTIFIC NOTES AND NEWS

DR. CHRISTOPHER ADDISON has been appointed the first minister of health in the Ministry of Health which has been established by the British Parliament. Dr. Addison was at one time professor of anatomy, University College, Sheffield. He was parliamentary secretary to the Board of Education, 1914–15, minister of munitions, 1916–17; minister of reconstruction, 1917, and has latterly occupied the office of president of the Local Government Board.

PROFESSOR F. SODDY has been elected a foreign member of the Swedish Academy of Sciences in succession to the late Sir William Crookes.

DR. CHAS. B. DAVENPORT, of the Carnegie Institution of Washington, has been elected associate of the Académie des Sciences de Belgique.

DR. HENRY G. BARBOUR, assistant professor of pharmacology in Yale University, has received a grant of $200 from the committee on

Scientific Research of the American Medical Association for the investigation of substances likely to be of value as anesthetics.

DON C. MOTE, formerly economic zoologist, Ohio Agricultural Experiment Station, has been appointed state entomologist of Arizona by the Arizona Commission of Agriculture and Horticulture, and assumed the duties of the office on July 1.

DR. A. G. MCCALL has terminated his services with the Army Educational Corps in France and has resumed his work as chief of the Soil Investigational Work at the Maryland Experiment Station.

MR. HARRY S. MORK has resigned as vice-president of Arthur D. Little, Inc., of Cambridge, Mass., and has been elected to the vice-presidency of the Lustron Company of Boston, manufacturers of artificial silk by a process developed in the Little establishment. He will also act as consultant to the Industrial Company of Boston.

DR. MAURICE H. GIVENS has resigned the assistant professorship of biological chemistry at the University of Rochester to accept the post of biochemist in the research laboratory at the Western Pennsylvania Hospital, Pittsburgh, Pa.

THE council of the British Scientific Instrument Research Association has appointed Mr. H. Moore to be assistant director of research.

THE American Scandinavian Foundation announces the names of ten American college students who will receive $1,000 each to enable them to go to Sweden to study in exchange with ten Swedish students to come to America. The men appointed are: Samuel G. Frantz, Princeton; Harry F. Yancey, University of Missouri; Chester C. Stewart, Massachusetts Institute of Technology; Harry W. Titus, University of Wyoming; Robert C. Sessions, Worcester Polytechnic Institute; Clarence N. Ostergren, Sheffield Scientific School; William S. Moir, Yale Forestry School; Henry M. Meloney, State School of Forestry at Syracuse University; Rudolph E. Zetterstrand, Sheffield Scientific School, and Thomas Fraser, University of Illinois.

ON July 1, Major Clarence J. West, recently in charge of the editorial department, Research Division, Chemical Warfare Service, assumed his duties as director of the information department of Arthur D. Little, Inc. In his new position Major West will extend the library facilities of the organization and develop a special information service on technical and scientific subjects for the benefit of the clients and staff of Arthur D. Little, Inc.

COLONEL HARRY L. GILCHRIST, of the Medical Corps, U. S. A., will command a group of 550 American Army officers and volunteers who will undertake to eliminate typhus from the camps and among the people in Poland.

PROFESSOR ALBERT JOHANNSEN, of the University of Chicago, has gone to Mexico City for the summer. He is doing petrographic work for the Mexican Survey.

MR. I. H. BOAS, M.Sc., of the Technical School, Perth, has left for Europe, America and India, where he will investigate Forest Products Laboratories. His report will form the basis of the Western Australian project.

PROFESSOR H. F. CLELLAND, of the department of geology, has been granted a leave of absence from Williams College for the coming college year.

DR. J. G. SANDERS, director of the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, at Harrisburg, Pa., has been commissioned by the Federal Horticultural Board at Washington to study the potato wart disease in the Briish Isles, and to note the methods adopted for controlling the spread of this most dangerous potato disease. The potato wart disease was first determined by him to occur in the United States in a district comprising four counties in the vicinity of Hazleton, Pa., in September, 1918. These four counties, with three outlying points, are now under strict quarantine.

ORGANIZED from the Scottish Oceanographical Laboratory, a surveying expedition left Edinburgh on June 16, for Spitsbergen, headed by Mr. John Mathieson, late divisional superintendent of Ordnance Survey in Scotland, who retired to take up this work. In

1909 Mr. Mathieson completed a survey of Prince Charles Foreland, Spitsbergen, which was begun in 1906 by Dr. W. S. Bruce, director of the Scottish Oceanographical Laboratory.

In connection with the physiology of the nervous system, given as a part of the course in general physiology at the Tufts College medical school, a series of three lectures was delivered on July 21, 22 and 23, by A. P. Weiss, of the department of psychology of Ohio State University, on "The place of behavior psychology in physiology."

The following lecturers at the Royal College of Physicians of London are announced: Dr. J. L. Birley, the Goulstonian; Sir W. Leishman, the Horace Dobell; Sir J. Rose Bralford, the Lumleian; and, for 1921, Dr. J. L. Golla, the Croonian.

The death is announced at the age of sixty-seven years of Dr. Emil Fischer, professor of chemistry in the University of Berlin. Dr. Fischer was awarded a Nobel prize in 1902.

Included in the Army Appropriation Bill, now passed by Congress, is an appropriation of $20,000 for the Surgeon-General's Library, and for the preservation of specimens for the Army Medical School, Washington, $10,000. An appropriation of $350,000 is made for the purchase of twenty-six acres of land adjoining Walter Reed Hospital, Washington, for the final location of the Army Medical School, Surgeon-General's Library and the Army Museum, and for the improvements on the land to be purchased.

The thirteenth annual meeting of the British Museums Association was held at Oxford, on July 8, and the two following days. Members were welcomed by Sir Herbert Warren, president of Magdalen. An address was given by the president, Sir H. Howarth, followed by the reading of a series of papers on museums in Oxford. Wednesday morning was occupied by discussions on the propriety of transferring the control of museums to the education authority, and on various matters of detail. On Thursday Dr. W. Evans Hoyle, curator of the Welsh Museum, Dr. F. A. Bather, of the Natural History Museum, and Mr. Isaac Williams, of Cardiff opened a discussion on the desirability of establishing a diploma for museum curators, and on the course of training that should be required. In the afternoon visits were paid to local museums and places of historic interest.

We learn from the London *Times* that the fifth annual general meeting of the Medico-Political Union was held in London on June 12. Dr. F. Coke, in his presidential address, said that 367 new members had joined during the last month. The report of the general secretary regretted the hostility which had sprung up between the British Medical Association and the Union. "The Association had for many years," the report proceeded, "while decrying trade unionism, been employing trade-union methods with impunity, until the Coventry case shattered their claims and left us as the only body adequately equipped to carry on a fight on behalf of the profession. I am pleased to say that the association, or certain of its members, recognize facts, and an attempt is now being made to reconcile differences." As to the formation of a ministry of health, the report stated that it foreshadowed drastic changes in the medical services at an early date. Those changes would benefit neither the community nor the profession, unless the latter had a large voice in shaping them. It was the duty of that union to impress on government departments the importance of the general practitioner as the backbone of the medical profession, and the fact that he was better equipped to give advice than those occupying a more exalted position. Resolutions were also passed in favor of the organization of the whole of the medical profession on a trade-union basis, and to the effect that a whole-time salaried service for general practitioners was undesirable.

UNIVERSITY AND EDUCATIONAL NEWS

The contract has just been signed for an addition to the laboratory of the department

of chemistry of the Rensselaer Polytechnic Institute to cost $175,000. The new wing will be devoted to laboratories for quantitative analysis, organic chemistry and physical chemistry. The new construction is necessary because of the growth in the number of students taking the courses in chemical engineering and general science.

DR. E. J. KRAUS, dean of service departments at the Oregon Agricultural College, has been appointed professor of applied botany at the University of Wisconsin.

PROFESSOR ALFRED ATKINSON, professor of agronomy in the Montana State College, succeeds President J. M. Hamilton, who has retired after serving for fifteen years.

MAJOR HENRY A. MATTILL, Sanitary Corps, formerly assistant professor of nutrition at the University of California, returned early in March from France, where he had charge of instruction in food and nutrition in the army schools at Langres. Dr. Mattill has accepted a junior professorship in biological chemistry at the University of Rochester.

DR. V. BUSH, now engineer of the American Radio and Research Co., has been appointed associate professor of electrical engineering at the Massachusetts Institute of Technology.

THE following promotions at Lehigh University have been announced: Assistant Professor R. L. Charles, physics, to become associate professor; Mr. P. B. Fraim, physics, assistant professor; Mr. J. S. Beamensderfer, mechanical engineering, assistant professor; Mr. H. C. Payrow, civil engineering, assistant professor, and Mr. M. S. Knebelman, mathematics, assistant professor.

AT Cambridge University Mr. W. E. Dixon, Downing College, has been appointed reader in pharmacology; Mr. J. E. Purvis, Corpus College, university lecturer in chemistry and physics in their application to hygiene and preventive medicine; Dr. Graham-Smith, university lecturer in hygiene, and Mr. T. S. P. Strangeways, St. John's, university lecturer in special pathology.

DISCUSSION AND CORRESPONDENCE

LIMICOLOUS OLIGOCHÆTA FOR LABORATORY USE

TO THE EDITOR OF SCIENCE: I should like to bring to the attention of teaching zoologists the advantages of living limicolous oligochæta, preferably a *Tubifex* or a *Limnodrilus*, for laboratory purposes in connection with exercises on the earthworm. In the movement which is developing in elementary courses to get away from mere study of structure, the introduction of some convenient and usable form for demonstrating functional activity in connection with so important a type as the earthworm is desirable. At Ohio State University we have used *Limnodrilus* with success. It is sufficiently transparent to allow the internal structures and processes of the annelid body to be observed. The entire alimentary tract is visible and the peristaltic action of the intestine can be demonstrated together with the effect this has on the material in the intestine. Frequently, too, it is possible to see the movements of the pharynx during ingestion. The contraction and the direction of blood flow in the main blood vessels can be observed. The movement of the setæ and their connection with the muscles operating them are also to be seen. The relation of the septa to body wall and intestine and the division of the cœlom into compartments is clearly apparent. It will thus be seen that these worms not only illustrate the annelid body, but also demonstrate functions of general application.

For laboratory use it is best to anesthetize the worms to the point of immobility. They should be placed in a watch glass partly filled with water and to this should be added a few drops of a saturated solution of chloretone. It is best to use a little at first, allow it to work for a while and then if necessary add more. The dish should be covered. With a little practise it is possible to have the worms immobile and yet keep the blood vessels and intestine active. For demonstrating ingestion and movement of the setæ no anesthetic should be used. Of course all activities are at their best in the unanesthetized worm if students have time and patience to follow the speci-

men. A binocular microscope or a 40-mm. lens on a compound instrument should be used. The worms are usually to be found in the bottom of almost any body of water where there is mud mixed with decayed vegetation. They can be kept indefinitely in aquaria having a layer of mud on the bottom.

F. H. KRECKER

OHIO STATE UNIVERSITY

THE CUMBERLAND FALLS METEORITE

THE stone described by Professor A. M. Miller in SCIENCE for June 6 of the present year, and of which the National Museum has secured the major portion, proves of exceptional interest. In fact, it is scarcely too much to say that it is one of the most remarkable falls yet reported on the American continent. The stone is a coarse enstatite breccia, closely compacted, showing evidences of compression while under a considerable load and other indications of its having formed a portion of a body of considerable size, even of planetary dimensions. The most striking macroscopical features aside from its brecciated structure are the occasional enclosures sometimes 4 or 5 cm. in diameter, of a dark, nearly black, chondritic stone. I do not recall another instance of so plain an admixture of stones of quite different type. Such a stone finds no exact position in the classification of Brezina. Following out the general plan, however, I have made a place for it among the achondrites and designated it a *Whitleyite*—a magnesia-rich stone brecciated in structure, consisting essentially of enstatite, poor in iron and carrying enclosures of a black chondrite. The results of further studies will be published elsewhere.

GEO. P. MERRILL

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.,
June 20, 1919

THE THIRD EDITION OF THE BIOGRAPHICAL DIRECTORY OF THE AMERICAN MEN OF SCIENCE

THE compilation and publication of the third edition of the *Biographical Directory of American Men of Science*, postponed on account of war conditions, will now be completed as rapidly as possible. The work is intended to be a contribution to the organization of science in America, and the editor will greatly appreciate the assistance of scientific men in making its contents accurate and complete. Those whose biographies appear in the second edition are requested to forward such alterations and additions as may be necessary or desirable, and to obtain biographical sketches from those who should be included or send their names and addresses. All those engaged in scientific work whose biographies are not included in the second edition are requested to send the information needed. For this purpose the blank that is given on an advertising page (ii) of the current issue of SCIENCE may be used.

It is intended that each entry shall contain information as follows:

1. The full name with title and mail address, the part of the name ordinarily omitted in correspondence being in parentheses.
2. The department of investigation given in italics.
3. The place and date of birth, including month and day.
4. Education and degrees, including honorary degrees.
5. Positions with dates, the present position being given in italics.
6. Temporary and minor positions; scientific awards and honors.
7. Membership in scientific societies with offices held.
8. Chief subjects in which research has been published or is now in progress.

All those in North America should be included in the book who have made contributions to the natural and exact sciences. The standards are expected to be about the same as those of fellowship in the American Association for the Advancement of Science or membership in the national scientific societies which require research work as a qualification.

The compilation of the new edition will of necessity involve much labor, but this will be materially lightened if men of science will reply promptly to this request.

J. MCKEEN CATTELL

GARRISON-ON-HUDSON, N. Y.

SCIENTIFIC BOOKS

The Indigenous Land Mammals of Porto Rico, Living and Extinct, Memoirs of the American Museum of Natural History, N. S., II., Pt. II., October, 1918. By H. E. ANTHONY.

Captain Anthony has been very fortunate in being able to study a very interesting phase of mammalian evolution; the borderline between the extinct and the recent. This fact makes his excellent memoir extremely interesting to students of vertebrate evolution. The work was attempted as a phase of an extensive survey of Porto Rico, covering the recent fauna and flora, the authropology and archeology; Captain Anthony confining his attention to the mammals. Most of the fossil forms are of Pleistocene age, though their nature is such as to lead Dr. Matthew to suggest to the American Philosophical Society[1] that Porto Rico and its adjacent islands have not been in direct communication with the mainland since the early Pliocene. The great body of the monograph, illustrated by 55 text figures and 76 photographic plates, is devoted to the systematic descriptions of the forms, chiefly bats. A few amphibian and reptilian bones were also discovered but these have not been discussed. The reptilian bones seem to be lizards of the general type of *Amblyrhynchus*, because of the presence of epiphyses. Anthony concludes:

> Judging from the character of the ancient mammalia, it (the fauna) must have reached the present islands at approximately some time in the period from the Oligocene to the end of the Miocene. In the Miocene the fauna of South America was of very much the same general character as that of the ancient island fauna and in the light of present-day knowledge of South American paleontology the relationships of most of the island mammals undoubtedly run back to the South American Miocene formations.

The presence of two large ground sloths, *Acratocnus odontrigonus* and *A. major* which the author compares with South American *Hapalops* and *Eucholœops* is an indication of the relationship of the early South American fauna with that of Porto Rico. The osteology of these two ground sloths, so far as known, is carefully illustrated and described.

ROY L. MOODIE

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UNIVERSITY OF ILLINOIS,
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[1] SCIENCE, N. S., XLIX., 546, 1919.

The Boys' Book of Chemistry. A Simple Explanation of Up-to-date Chemistry. Together with Many Easily Made Experiments. By CHARLES RAMSAY CLARKE. New York, E. P. Dutton & Company. 1918.

It is so obviously desirable that the youth of to-day should take a keen interest in chemical science, to which such prominence has been given in the war-time activities that one would welcome the appearance of a satisfactory book for boys' use. Unfortunately "The Boys' Book of Chemistry" is not only a disappointment, but it is one of the most pernicious little volumes that has appeared for a long time. The chemical statements are absolutely wrong in a considerable number of instances and misleading in many more, and the book is subject to severe criticism both as to its English and the arrangement of its subject matter. The degree of judgment shown in the selection of material is perhaps sufficiently indicated by the statement that in the chapter entitled Synthetic Chemistry for Beginners the first four syntheses are those of camphor, indigo, tannin and rubber; and these are given in mere outline form which is practically valueless to the reader, boy or man. At a time when books which will lead to an intelligent interest in chemistry are so desirable, it is unfortunate that this volume should appear to the confusion of its readers.

H. P. TALBOT

NOTES ON METEOROLOGY AND CLIMATOLOGY

METEOROLOGICAL ASPECTS OF TRANSATLANTIC FLIGHT

DURING the early preparations for the trans-Atlantic flight most of the discussion centered on the machines themselves, but when it became evident that airplanes and dirigibles could stay in the air long enough to accom-

plish the flight, the interest in the meteorological aspects became more manifest. And when aviators intending to fly across the Atlantic had to wait many weeks for favorable weather, the importance of the meteorological conditions became recognized as paramount.

"Trans-Atlantic flight from a meteorologist's point of view," was discussed in detail by Mr. W. R. Gregg, of the Weather Bureau, at a meeting of the Philosophical Society of Washington, March 29, 1919; and this paper was published widely during the first half of May.[1] In the selection of routes for trans-Atlantic flight, helpful winds as well as geographical distance must be considered. Thus, the best eastward routes are Newfoundland to Ireland and Newfoundland to the Azores and Portugal; while the best westward routes, so far as wind aid is concerned, are (1) Scotland to Labrador via Iceland and Greenland, (2) Portugal to the West Indies, and (3) Africa near Cape Verde, to eastern Brazil. Since eastward flight from Newfoundland offers the best initial possibilities for airplanes, Mr. Gregg confined his discussion to the weather conditions in the middle latitudes of the North Atlantic.

The temperatures in winter or summer are usually not extreme. The moisture of the air over the oceans is of importance only in its connection with fogginess, cloudiness and precipitation. The average cloudiness along the more northern route (Newfoundland to Ireland) is about 70 per cent., but this includes the thick fogs as well as the clouds. Fortunately, the aviator can generally rise above the clouds for observation, and over the sea, it is not so dangerous to fly below low clouds as it is over the land. Rainfall occurs very frequently, *i. e.*, on about two thirds of the days—but, here again, it is possible for the aviator to fly high and thus to avoid the heaviest rain. Fog, while a grave danger in trying to land, or in flying low, usually does not extend high. On the Grand Banks fogs occur on about 60 per cent. of the days in summer and 20 to 35 per cent. of those in winter; on the Irish coast the percentages are 10 and 5, respectively. Since these fogs do not usually extend very far inland, they seldom would prevent landing. The vertical extent of the Newfoundland fogs is almost always less than 250 meters, and so can easily be left below the flier at the start.

[1] See *Monthly Weather Review*, 1919, Vol. 47, pp. 65–75.

The general pressure distribution and winds favor eastward flight, though the frequency of gales is unfavorable, gales occurring on about 25 per cent. of the days in winter and 5 in summer on the Newfoundland to Ireland route, and slightly less often on the Newfoundland to the Azores and Portugal route. Tropical cyclones, fortunately, are rare. The conditions in the free air are not very different from those on the surface, for over the ocean the wind increases and turns but little with altitude, the surface friction being very small relative to that over the land.

While the average conditions are generally favorable for eastward flight in middle latitudes across the North Atlantic, the actual conditions at a particular time are those which must be encountered. The problem, then, is to choose a day on which the winds will be most favorable. Mr. Gregg chose from among the daily weather maps of the North Atlantic on file at the Weather Bureau, May 29, 1906, as a day which would have been a good one for a start. By interpolating weather maps at two-hour intervals he computed for eight divisions of a flight from Newfoundland to Ireland, the direction and velocities of the "gradient" winds, and from these the proper bearings of an airplane's course which would carry it to Ireland with the aid of the wind, in the shortest possible time. He computed not only the bearing of the course, but also the direction in which the airplane would have to move relative to the air in order to maintain the necessary bearing for the stipulated distances of each part of the course. On May 29–30, 1906, an airplane with an air-speed of 90 mi./hr. could have made the flight in 17 hours, whereas in a calm 20 hours would have been necessary.

With the aid of Messrs. Tingley and Paterson of the marine division of the Weather

Bureau, Mr. Gregg also classified the daily weather maps of the North Atlantic for a ten-year period into days when wind conditions were excellent, good, fair, or poor for the journeys both ways and both routes. Grouping the excellent and good days together, the average number of days in May favoring Newfoundland to Ireland flight is 12, Newfoundland to Portugal, 11, and return on both routes, only 2. For June, the corresponding figures are 10, 6 and 2. While on the average there should be plenty of favorable days, individual months vary greatly. Thus, in July, 1906, there were 28 favorable days for the trip to Ireland, but in July 1907, only 4.

Mr. Gregg's general conclusions are worth quoting:

CONCLUSIONS

1. In the present stage of their development and until improvements give them a much larger cruising radius than they now have, airplanes can not safely be used for trans-Atlantic flight except under favorable conditions of wind and weather.

2. Observations of conditions over as great an area as possible, and particularly along and near any proposed course, should therefore be available at as frequent intervals as possible, these observations to include free-air as well as surface conditions.

3. With such observations at hand the meteorologist is able quickly to determine the current, and probable future, wind conditions along a proposed route and to advise an aviator as to the suitability of a day for a flight.

4. If a day is favorable, the meteorologist is able to indicate the successive directions toward which an airplane should be headed in order to keep to any desired course; also, to calculate the assistance that will be furnished by the winds.

5. Inspection of marine weather maps shows that at an altitude of 500 to 1,000 meters conditions are favorable for an eastward trip approximately one third of the time, the percentage being slightly greater along the northern than along the southern route. At greater altitudes the percentage of favorable days materially increases, especially along the northern route. For the westward trip the percentage of favorable days is so small as to make trans-Atlantic flight in this direction impracticable until the cruising radius of aircraft is increased to such an extent that they are relatively independent of wind conditions.

6. All things considered, conditions for an eastward flight are most favorable along the northern course; for a westward flight they are most favorable along the southern course; that is, the prevailing westerlies are less persistent along this course than farther north.

7. There seems to be little choice as to season, for, although the prevailing westerlies are stronger in winter than in summer, yet, on the other hand, stormy conditions are more prevalent in winter, and the net result is about an equal percentage of favorable days in the two seasons. Moreover, the greater fog percentage in summer just about offsets the greater percentage of cloudiness in winter. Fog is a disadvantage chiefly because of its interference in making observations with drift indicators. The Newfoundland fogs in general are of small vertical extent and do not extend far inland. They should not, therefore, prove a hindrance to landing, if the landing field is located some distance from the coast.

8. Most important of all, there is need for a comprehensive campaign of meteorological and aerological observations over the North Atlantic in order that aviators may be given data for whose accuracy the meteorologist need not hesitate to vouch, instead of information based on so small a number of observations, particularly of free air conditions, that the deductions, including some of those in this paper, are assumed and not proved, are given with caution, and are "subject to change without notice."

How some of these conclusions have worked out in actual practise is being discussed in contributions to be published in the *Monthly Weather Review*.

CHARLES F. BROOKS

WASHINGTON, D. C.

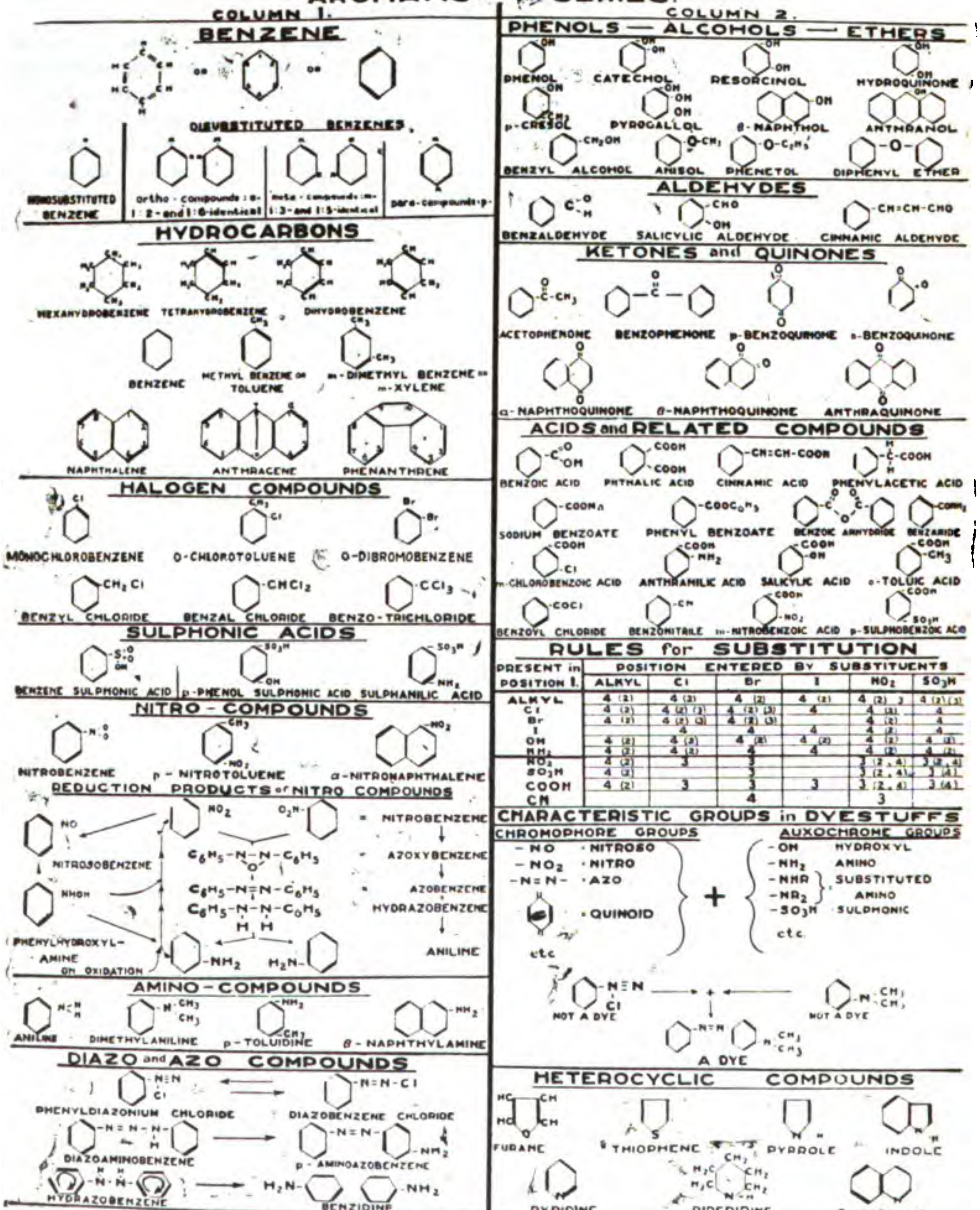
SPECIAL ARTICLES

A CHART OF ORGANIC CHEMISTRY, AROMATIC SERIES

THE following chart was made and is used in connection with the elementary organic chemistry course given at the university. The heavy type lines in the benzene rings indicate the double bonds while the light lines indicate the single bonds. In order to emphasize certain characteristic groups, position of substituents in the rings, etc., red lettering was used. In the following miniature

ORGANIC TYPE FORMULAE

AROMATIC SERIES.



RULES for SUBSTITUTION

PRESENT in POSITION 1.	POSITION ENTERED BY SUBSTITUENTS: ALKYL	Cl	Br	I	NO_2	SO_3H
ALKYL	4 (2)	4 (2)	4 (2)	4 (2)	4 (2) 3	4 (2) (3)
Cl	4 (2)	4 (2) (3)	4 (2) (3)	4	4 (2)	4
Br	4 (2)	4 (2) (3)	4 (2) (3)		4 (2)	4
I		4	4	4	4 (2)	4
OH	4 (2)	4 (2)	4 (2)	4 (2)	4 (2)	4 (2)
NH_2	4 (2)	4 (2)	4	4	4 (2)	4 (2)
NO_2	4 (2)	3	3		3 (2, 4)	3 (2, 4)
SO_3H	4 (2)		3		3 (2, 4)	3 (4)
COOH	4 (2)	3	3	3	3 (2, 4)	3 (4)
CN			4		3	

COMPILED BY ALEXANDER LOWY

chart the corresponding red lettering can not be shown.

The chart is $98'' \times 75''$.

An analogous chart of the aliphatic series was described in SCIENCE.

ALEXANDER LOWY
UNIVERSITY OF PITTSBURGH

THE KENTUCKY ACADEMY OF SCIENCE

THE Kentucky Academy of Science held its sixth annual meeting at the University of Kentucky on Saturday, May 3, 1919, with J. E. Barton, president, in the chair. After a brief business session at which a number of new members were elected, the following program was presented:

President's address, by J. E. Barton, "The relation of private forestry to the economic interests of Kentucky."

It was brought out that there are no public forests in Kentucky, the large bodies of forest lands being privately owned, mainly by coal companies. The preservation of timber in Kentucky is therefore a problem in private forestry. It was considered desirable that the legislature should pass some law regulating private forests and stimulating timber development by suitable modification of the methods of taxing timber land.

New fossil invertebrates from a new fossil horizon in the coal measures of eastern Kentucky: W. R. JILLSON, state geologist. A new fossiliferous limestone horizon in the Coal Measures of eastern Kentucky has been discovered by the author who has done sufficient field work on it to demonstrate that it possesses features of fundamental stratigraphic importance to the unmapped geology of this section. A comprehensive collection of invertebrates taken by the author from an outcrop of this horizon on the Dr. G. T. Kendrick farm on the headwaters of Cow Creek, Floyd county, and identified by Professor Charles Schuchert, shows an incomplete list of about forty species of which ten are new and about sixteen very rare. It is a very unusual Pottsville fauna with the characteristic index forms absent. Three other widespread fossiliferous limestones in this same area are noted, all of which possess virgin stratigraphic potentialities. The author tentatively correlates them into the Norton (Middle) and Wise (Upper) Pottsville.

A phase of evolution: W. S. ANDERSON. In every breed of animals it is found that a few are exceptionally potent in passing on their good qualities. The author illustrated this from certain families of horses and advanced some speculations as to the possible cause.

Electrolytic solution glow: DEAN W. MARTIN. In December, 1917, the author observed a glow on the aluminum terminal of an electrolytic rectifier with lead and aluminum electrodes in a 10 per cent. solution of sodium phosphate. It was found possible to produce the glow with solutions of many different salts, of different concentrations, at temperatures from 0 to 100° and with electrodes of aluminum, zinc or magnesium and with voltages ranging from 80 to 1,500. A simple apparatus was exhibited and production of the glow was demonstrated. The observation is published for the purpose of learning whether others have noted or investigated the phenomenon.

The bacteriological descriptive group number: D. J. HEALY. The author has found it necessary to develop the group number of the Society of American Bacteriologists in such a manner that it will indicate the action of soil bacteria on nitrogenous compounds, organic acids and sulfur. The group number, enlarged in this manner, has proved valuable in the study of soil bacteria.

A brief discussion of Lexington sewage purification: H. D. SPEARS. A modern sewage-disposal plant operated by gravity takes care of 3,000,000 gallons containing 2½ tons of suspended solids. The sewage passes through bar screens and grit chambers into Imhoff tanks, where bacterial action takes place and sludge is deposited. The effluent passes into "dosing tanks" which empty automatically every 15 minutes into filter beds, 2 acres area, of coarsely broken limestone covered with broken granite, together 6 feet deep. Thence the effluent passes through secondary sedimentation tanks and into a near-by stream. It is clear, odorless and has a "relative stability" of about 95 per cent. The sludge from the Imhoff tank is drawn off periodically into drying beds whence it is returned to the soil, when spadable.

A specimen of lodestone from Kentucky: A. M. PETER. A specimen of titaniferous magnetite possessing polarity was exhibited, which had been sent in from Edmondson county.

The composition of the ash of crab grass (Digitaria sanguinalis) as affected by the soil in which it is grown: G. DAVIS BUCKNER. Crab grass (*Digitaria sanguinalis*), when grown in garden soil, contains an ash which is 16.1 per cent. larger than the ash of the same species when grown in a 4-inch limestone roadway. The comparative composition

of the ashes shows that the sample grown in limestone contains 22.7 per cent. more P_2O_5; 44.0 per cent. more CaO; 27.6 per cent. more MgO, and 18.8 per cent. less K_2O than the one grown in garden soil. The external appearance of these two samples was identical.

Some experiments in adsorption phenomena: P. L. Blumenthal, D. J. Healy and A. M. Peter. (Presented by P. L. Blumenthal.) The adsorption of crystal violet by powdered phlogopite was demonstrated and it was shown that the mineral which had been acted upon by bacterial cultures withdrew from dilute solution more of the dye than did the untreated mineral, weight for weight.

An improved astatic galvanometer: C. C. Kiplinger. A new coil for an astatic galvanometer has been designed, the simplicity and efficiency of which is described. A current equivalent to 1° C. temperature difference between the terminals of a 5 couple iron-germansilver thermopile shows a swing of 8 inches on a scale 50 inches from the instrument.

A modified ebullioscopic apparatus for accurate molecular weight determinations: C. C. Kiplinger. A method is suggested whereby an ebullioscopic apparatus may be made independent of variations in atmospheric pressure. It has been shown that molecular weights may be determined by this method of comparison without any knowledge of the constant for the given solvent, thus rendering the experiment independent of previous experimental errors involved in the determination of *C*.

Notes on the viability of tobacco seed: G. C. Routt. Experience in Canada shows that home-grown seed germinates better than seed from more southern localities and a higher percentage of viable seed are set during bright, warm weather than when cool, cloudy weather prevails. A higher percentage of germination is obtained from seeds gathered when the pods are half brown than when they are left until the pods are wholly brown. Tobacco seed retains its viability for many years; a sample eight years old having shown 95 per cent. germination, and one twelve years old, 70 per cent.

The projection of water waves: N. F. Smith. A simple method was described by which surface waves in water could be produced and projected by means of the lantern so as to illustrate important characteristics of wave motion.

The McCreary county aerolite: A. M. Miller. Portions of the aerolite which recently fell in McCreary county, Ky., were exhibited and an account of the occurrence was given. The body is stony and nearly white, containing very little metallic iron. Dr. Peter reported a qualitative chemical analysis showing that the mineral is essentially a magnesium silicate, probably enstatite. Metallic particles amounting to less than 0.2 per cent. were shown to be nickeliferous iron. Chromium, phosphorus and sulfur were detected.

The discovery of a mica deposit in eastern Kentucky: W. R. Jillson. The author announces the discovery of a single stratigraphic unit deposit of nearly pure flake mica in the Pottsville of Pike county—the first in Kentucky.

At the afternoon session Dr. E. B. Hart, of the University of Wisconsin, Madison, Wis., addressed the academy on "The widening viewpoint in animal nutrition."

An illustrated discussion was given of the most important results of investigations concerning nutrition which had been conducted in his laboratory at the University of Wisconsin and elsewhere. A brief account was given of the accumulative toxic properties of wheat embryos and the corrective properties of corn stover which, however, did not equal the legume hays in this respect. The vitamine factor was briefly discussed as were the subjects of roughage, protein efficiency, and the necessity of inorganic salts. Finally it was stated that a balanced diet must contain sufficient fuel value, efficient proteins, food accessories, roughages and inorganic salts and be sensibly free from toxic material.

Officers were elected as follows: Dr. Paul P. Boyd, president; Dr. Walter H. Coolidge, vice-president; Dr. Alfred M. Peter, secretary; Mr. J. S. McHargue, treasurer.

Alfred M. Peter,
Secretary

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CONTENTS

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A NATIONAL LABORATORY OF HUMAN NUTRITION[1]

THE Inter-Allied Scientific Food Commission, which held meetings during the spring and early summer of 1918 in Paris, Rome and London, decided to recommend to the four governments represented, those of France, Italy, England and the United States, that a laboratory for the study of human nutrition be established in each of those countries. The commission called attention to the fact that at least one quarter of the income of a nation is devoted to the purchase of food by its individual citizens and that, since the poorer the individual the greater is the proportion of his wage devoted to the purchase of food, it is therefore a matter of the highest importance for the welfare and prosperity of a country that the methods of the best possible utilization of its food resources for the benefit of its citizens be sought out and in time definitely established by reliable scientific data.

The comforts which one enjoys in the modern world are derived from the advance of science. Though the so-called "practical man" says he will accept no "theories," yet in reality he never acts except upon some theory of his own. The difference in the value of the opinions of the "practical man" and the "scientific man" is that the theories of the latter are more likely to be correct than those of the former.

If one looks back into history one notes the influence which an American-born scientist, Count Rumford, had upon the fortunes of Bavaria. Among the 60,000 inhabitants residing in Munich there were so many beggars and vagabonds, who were all potential thieves, that in the year 1790 Rumford authorized the seizure of 2,600 in one week and put them to

[1] A paper prepared in London in June, 1918, at the request of Professor Langlois for publication in France.

work under well-ordered and kindly direction. He also provided a soup kitchen which could feed a thousand or more people, and he prided himself that it cost only half a franc to pay for the fuel to cook for a thousand persons. He endeavored to introduce the use of maize meal into Bavaria and gave exact directions as to its cooking. He employed soldiers, who had acquired habits of indolence, upon public works. He arranged little gardens for the military, in which they cultivated potatoes, and through his improvements in the processes of cooking, by means of better boilers which consumed less fuel, he endeavored to make the soldiers much more comfortable than they had ever been before and at much less cost. He sought to improve the live stock of the country by proper breeding. He believed that science was at the foundation of all reformatory enterprise and in his own words sought "the providing of the wants of the poor and securing their happiness and comfort by the introduction of order and industry among them." And his results were successful because his theories were sound.

One can trace the life of this Bavarian community yet further, for in 1822 Liebig resided in Paris and met there the pupils of the great French scientist, the immortal Lavoisier. Liebig took back with him the fundamental truths discovered by this great Frenchman and later the town of Munich built the first great chemical laboratory, a laboratory destined to become the one in which his successor enriched the world by the discovery of artificial alizarine.

Lavoisier was the first to establish the modern truths concerning the nutrition of man and stated "La vie est une fonction chimique." He called attention to the fact that his experiments showed that the poor laboring man needed more food than the rich man who did no work, and yet that the laborer was much the less likely of the two to get sufficient food.

The provision of man with adequate food is a social obligation of the highest importance. In the middle of the eighteenth century Benjamin Franklin noted that where there was famine there was disorder, and that where there was disorder famine followed in its train. This, indeed, we now believe to be the sum and substance of the recent Russian revolution. After the Napoleonic wars famine devastated portions of Europe. In Magendie's "Journal de physiologie"[2] there is an account of famine which occurred in six provinces of France during the winter of 1817, the second following the Congress of Vienna, a time of great distress in Europe. A dropsy of a peculiar kind developed. Curiously enough, just one hundred years later, in January, 1917, a malady called "war edema," broke out in Germany and Austria, especially among prisoners of war. The cause of the disease was attributed to lack of nourishment, especially to lack of fat in the diet, for after giving 100 grams of fat daily for a week to each of three different patients a complete cure was effected without resort to any other remedy.

A national laboratory of human nutrition would have many unsolved questions to answer and perhaps a few of these questions might be suggested in this article.

There should be researches into the requirements of food necessary to maintain health, strength and work in men, women and children engaged in various occupations. It is well known that a man who is over the average weight is an inefficient laborer, but it is not certain whether a man who is reduced in weight and receives good food is as efficient as when he is of average weight. He might easily be just as effective and possibly more effective a worker when thin than when of average weight.

Another important question is whether the ration of about 500 grams of meat per day which has existed for over a hundred years in the American and English armies is not altogether too high for production of the maximum of physical work which can be accomplished by a soldier. It may well be that such a diet of meat may tend to mental relaxation and to a sensation of difficulty in the performance of a task, such as has been actually ob-

[2] Gaspard, B., "Effets des alimens végétaux herbacés," *Journal de physiologie*, 1821, I., 237.

served in laboratory experiments upon men who have taken large quantities of meat.

Furthermore, it would be interesting to know how much milk is required every day for children of various ages. It is not known to-day how much milk must be taken to prevent rickets developing in children.

It is also unknown how much food a child should be given at different ages, or whether a boy needs more additional food in order to do a certain amount of work than his father would need to accomplish the same amount of work. It may be that the growing muscles of a boy are not as efficient machines as those of an adult.

Then there is a vast field in the study of the psychology of food. The Jews are told as children that pork is unfit for food and they rarely conquer their repugnance to it. The English are told as children that maize is food for pigs, and though Americans eat maize bread with pleasure and have recently done so to a huge extent in order to make possible exports of wheat to Europe, the English persist in their unfounded prejudice against it. I once had a diabetic patient who was one of my own students and he had heard me say in my lectures that the sugar levulose was the only sugar that could be used by the body in that disease. When 100 grams of levulose were given to him he was apparently greatly benefited. His strength improved, as measured with an ergograph, and all his classmates remarked upon the wonderful change in his spirits. Alas, none of the sugar was used in his body and all the apparent benefit was derived from mental suggestion. In this little story lies the essence of much sincere self deception, as well as the foundation of dangerous frauds, such as are exploited by makers of patent medicines. It is also evident that the testimony to the effect that 500 grams of meat are desirable for a soldier may rest on an extremely shaky foundation.

A laboratory of human nutrition should have at its disposal a close statistical analysis of the available food supply of the country and should be able to advise the government so that a sufficient quantity of suitable food may be always available. Thus, chemical analysis of the food products, which would show approximately the quantity of food materials obtainable from any given source, such as maize or hogs or cattle, should each year be determined.

There should also be an investigation into the food resources of the country so that they may be used in the best interests of human beings. For example, it is wrong to feed bread grains to pigs when human beings need them more.

If these four laboratories, British, French, Italian and American, be established, the directors should meet together annually and discuss results. And it would be wise to arrange for the exchange of trained assistants.

It may be said that to build a nutrition laboratory would be too costly for the state. In this connection it should be remembered that in Germany for the past eighty years, even in times of her greatest poverty, money has always been spent for laboratories accompanied by recognition of her scientific men, and these things made her rich and powerful more rapidly than culture lessened her inherent barbarism. Before gold was discovered in Alaska and in South Africa, I heard a professor of geology in New York say that the geological formation in these two sections was such that gold probably existed there. Other people got the gold that the scientist knew about. Take another illustration. Biffen, of Cambridge, England, developed a new brand of wheat called "Little Joss." In 1913 this brand of wheat was sown and it produced four bushels per acre more wheat than any other variety. The gain to the farmers that one year alone amounted to $1,000,000, while the laboratory in which the work was done cost $200,000 to build. It is probable that the work of a nutrition laboratory especially designed for investigations into the food requirements of man could be carried on at an expense of less than one hundredth part of one per cent. of the cost of the food supply of each of the Allied Nations, and if the director of such a laboratory were a man of broad vision and creative imagination, the laboratory would be certain to add to the knowledge of the

world, to the welfare of the community and to the dignity and honor of the nation.

GRAHAM LUSK
CORNELL MEDICAL COLLEGE,
NEW YORK CITY

THE IRWIN EXPEDITION[1]

THE Irwin Expedition of Indiana University organized in cooperation with the University of Illinois which started in June, 1918, to study the fresh-water fishes of Peru and Chile and of the Titicaca basin, has returned, bringing very large collections. Miss Adele Eigenmann, a medical student in Indiana University, returned in January, Mr. W. R. Allen traveling fellow of the University of Illinois, returned in April, and I returned the first of June.

Aside from the institutions mentioned the expedition had the cooperation of the American Association for the Advancement of Science, and the Bache Fund of the National Academy of Sciences.

Five weeks were lost in New Orleans waiting for passports. This delay made it inadvisable to attempt to cross the Andes at Cajamarca as planned and the expedition went directly to Callao. From Callao we went together over the Central Railway of Peru to Oroya. From Oroya Mr. Allen went to Lake Junin and down the valley of the Huallaga. Miss Eigenmann and myself first went south as far as Huancayo, later east to La Merced, at an elevation of 2,500 feet, then north to Cerro de Pasco and Gollalarsquisca, then to Casapalca, from where we examined various lakes, reaching an elevation of 15,900 feet. We then returned to the coast, went south by steamer to Mollendo, and by the Southern Railway over the crest of the Andes at Crucero Alto (nearly 14,000 feet) and north to Cuzco. Collections were made at Cuzco, in Lakes Lucre, Urcos, and Langilaio, Chinchero and Huaipo, and in the Urubamba, from its source at La Raya (13,370 feet) to Santa Ana, in the tropics at an elevation of 2,500 feet. We visited La Paz to secure concessions for Mr. Allen in Bolivia, and then we returned to Lima, at the end of 1918. Early in January we went by steamer north to Paita, from where Miss Adele returned home. I went inland from Paita to Piura, south to Pacasmayo and inland from Pacasmayo to Llallan. I returned to Lima at the end of January.

Mr. Allen, after some delay from fevers and other causes, returned from the Huallaga early in November to Lima, and then went direct to Lake Titicaca. He spent the time from December to May about Lake Titicaca. He went entirely around the lake, in part by rail, in part by boat, and in part afoot, collecting in many of the tributaries. He devoted particular attention to securing a set of the parasites of the fishes of Titicaca for the University of Illinois. It is hoped that the parasites will give some indication of the origin of the peculiar fishes so abundant in the high Andean lakes.

In February I went south to Chile, and collected in some of the rivers between Puerto Montt and the Rio Copiapo, which is the last of the rivers south of the Desert of Atacama. I also crossed from Puerto Varas, on Lake Llanquihue, to Lake Nahuel-Huapi, in the Argentine, collecting on the way in Lake Todos Santos and in Laguna Fria.

Large quantities of material were collected, and it will take many months to make a complete report. It is interesting to state that we secured four distinct faunas. The fish fauna of the region about Puerto Montt is highly tinctured with species belonging to families that are also found in Australia. These begin to decrease north of Valdivia. At Conception, aside from the lampreys, only one Australian type was found. The fauna about Santiago is quite different from that about Puerto Montt, and north of Santiago this fauna gradually dwindles. In the last river south of the desert, at Copiapo, only introduced gold fishes were found. It is probable that pejereyes and other fishes of marine origin are to be found about the mouth of this river. About Copiapo it rarely rains, but at Puerto Montt and Valdivia in the south the

[1] Mr. Will G. Irwin, of Columbus, Ind., made the expedition possible. See SCIENCE, August 2, 1918.

rainfall is very excessive. The faunas of western Ecuador and western Colombia are distinctly Amazonian in type and in northern Peru, at Piura, the fauna is Ecuadorian. The species decrease in number from north to south. The exact point where the northern Amazonian fauna disappears and the Chilean fauna begins has not been determined.

The Titicaca fauna is distinct and very interesting. No other lake of the same altitude has as many species; all of the species of the lake belong to two genera, *Orestias* and *Pygidium*. *Pygidium* is a genus of catfishes distributed over all the mountains of South America. The species found in Lake Titicaca is one of the largest of the genus and of some economic importance. The other genus, *Orestias*, is confined to the Andean lakes of Peru and Bolivia. There are a number of species in Lake Titicaca; some of them reach a foot, more or less, in length, and are brought to the markets about the lake. Others are minute, and sold in the markets in the neighborhood dried. *Orestias* is found northward at least to Cerro de Pasco, both in lakes and in stagnant portions of the rivers. It extends down the Urubamba valley to Ollantaitambo, and in the Oroya valley at least to Huancayo. It is essentially an Alpine genus, ranging from about 7,000 feet to over 15,000 feet in elevation. Considerable effort was made to get species from the lakes near Titicaca. Near Ticlio, the crest of the Central Railway of Peru, specimens were secured at an elevation of more than 15,000 feet.

The expedition had the heartiest cooperation of the authorities in both Chile and Peru. In Chile the government provided railway transportation. Professor Maldonado, of the Chilean government, will extend the examination of the Chilean rivers south of Puerto Montt. In Peru, Mr. Cesar Elguera, of the foreign office, took particular interest in the success of the expedition, and provided, through the government, the free entry of the equipment, and passes over the steamship lines between Paita and Mollendo. President Pardo of Peru furnished the expedition with orders to the prefects of Arequipa, Puno and of Cuzco to give us all facilities and they carried out the recommendations. The Prefect of Cuzco, Colonel Gonzales, took particular interest in the expedition, furnishing a sergeant as companion and interpreter between Quetchua and Spanish. Sergeant Medina carried orders from the prefect authorizing him to requisition anything needed by the expedition along its way and became an enthusiastic fisherman. Mr. Morquill, president of the Peruvian Company, gave the expedition passes over all the railways of Peru; and Mr. Blaisdell, manager of the Southern Railway of Peru, supplemented these by orders to the various officials along the line. The cooperation of Mr. Morquill and Mr. Blaisdell meant much more than the saving of railroad fares.

Of private individuals, Señor Duque, who entertained the expedition at Santa Ana, and Sr. Corazao, at Ollantaitambo, deserve first mention. Mr. Rawlins, Mr. Babbit, Mr. Murdock and Mr. Emerson, of the Cerro de Pasco Corporation, and Mr. Roper, of the Backus and Johnson Company, helped by supplying horses, living accommodations and beasts to explore the high lakes between Casapalca and Gollalarsquisca. Messrs. Bridge and Woodbridge, of the Transandean Railway of Chile, provided for a trip to the crest of the Andes in Chile. Mr. Roth helped in various ways on the trip between Puerto Varas and the Argentine, and many others helped in one way or another.

In conclusion, it must be mentioned that President Prado and Professor Rospigliosi, of the University of San Marcos, in addition to numerous courtesies have promised cooperation in other expeditions planned for the part of Peru east of the Andes.

The only item that hampered the expedition was the delay in the first instance in rendering a decision on passports. Passports were then refused. A direct appeal by Indiana University and the University of Illinois to President Wilson brought a commutation of the sentence rendered by the state department, on charges preferred by a person who in his modesty does not want to be made

known. Five weeks were lost at New Orleans and the trip from Cajamarca to the Marañon had to be omitted.

Carl H. Eigenmann
Indiana University

DR. ABRAHAM JACOBI (1830–1919)

Dr. Abraham Jacobi, the father and founder of American pediatrics, died at his summer home at Bolton Landing, N. Y., on July 10, at the age of eighty-nine years.

Dr. Jacobi was born of Jewish parents in the village of Hartum, Westphalia, on May 6, 1830. His people were not well-to-do, his education was accomplished through privation and struggle, but he early acquired a knowledge of Latin, and, after the usual courses of instruction in the village school and the Gymnasium at Minden, he went to the University of Greifswald, in 1847, at the age of seventeen, to matriculate as a student of Oriental languages. Becoming interested in medicine, he turned to anatomy and physiology. Following the peripatetic plan of the German student, he proceeded to Göttingen, where he came under Frerichs and Woehler, winding up his course at Bonn, where he graduated in 1851, with a Latin dissertation "Cogitationes de vita rerum naturalium," which has considerable philosophic depth. In the meantime, the Revolution of 1848 had broken out and run its course, and in this brief drive for liberty, Jacobi, with Ferdinand Freiligrath, Karl Marx, Carl Schurz and others, had been a leading spirit. When he went to Berlin, to take his state examination, he was apprehended by the Prussian authorities, imprisoned for a year and a half in a German fortress at Cologne, convicted of lèse majesté, and again held in detention for six months at Minden. In 1853, through the friendship of his jailer, he managed to escape, took ship at Hamburg, and after some vicissitudes in England and New England, settled down to practise at 20 Howard Street, New York. Here, beginning with such modest fees as 25 and 50 cents for office and house visits, five to ten dollars for obstetric cases, he soon managed to make a living. In the first year of his practise, he made \$973.25. During the next year (1854), he invented a laryngoscope of his own, which was unfortunately not ever patented or made public before the appearance of Manuel Garcia's instrument (1855). By 1857, Jacobi was lecturing on pediatrics in the College of Physicians and Surgeons of New York. This was the starting point of clinical and scientific pediatrics in this country. In this branch of medicine, Jacobi had only one other American colleague (in no sense a rival or competitor), the devoted and unworldly J. Lewis Smith, whose famous treatise of 1869 passed through eight editions. In 1860, Jacobi was called to the first special chair of diseases of children in the New York Medical College; in 1861, Smith became clinical professor of pediatrics in the Bellevue Hospital College. In 1865, Jacobi took the clinical chair of his subject in the medical department of the University of New York. In 1870, he became clinical professor of pediatrics in the College of Physicians and Surgeons (1870–99). Officially, he taught pediatrics in New York for nearly half a century, actually, all his working life.

In 1862, Jacobi established a pediatric clinic in the New York Medical College Building in East 13th Street, which ran for two years. In this way, bedside teaching in pediatrics antedated bedside teaching in internal medicine in the United States.

Meanwhile, Jacobi had been an active and brilliant contributor to medical literature. In 1859, he published a volume of "Contributions to Midwifery and Diseases of Women and Children," with Emil Noeggerath,[1] who was to be Jacobi's coadjutor in founding the *American Journal of Obstetrics* (1862) . During 1859–1903, Jacobi wrote much on diphtheria, and published successive treatises on diseases of the larynx (1859), dentition and its derangements (1862), infant diet (1872), diphtheria (1876), intestinal diseases of infancy and childhood (1887), diseases of the thymus gland (1889) and therapeutics of infancy and child-

[1] Author of the now well-established theory of the latency of gonorrhœa in unsuspected carriers (1872), which has been of great moment in the science of causation of pelvic disease in women.

hood (1896–1903). The tendency of these books is mainly practical, to spread the pediatric doctrine as applied science. The treatise on infantile therapeutics is, in reality, a treatise on pediatrics, summarizing the author's views and revealing his wide knowledge of the literature. To the medical periodicals, Jacobi contributed many papers, including his more original observations of infantile disease. His most enduring contributions to his science are perhaps the three monographs in the Gerhardt "Handbuch" on infant hygiene (1876), diphtheria (1877) and dysentery (1877). These, the products of a man approaching fifty, have all the force and fire of youth. To the history of pediatrics, Jacobi contributed the most important American papers, notably his St. Louis address (1904), two authoritative histories of American pediatrics (1902, 1913), a history of cerebrospinal meningitis in America (1905) and a history of pediatrics in New York City (1917). In sixty-six years of active practise he wrote an enormous number of miscellaneous papers of the most varied kind, most of which have been gathered in eight volumes ("Collectanea Jacobi," 1909). These include some of the wisest and wittiest discourses in medical literature. As a pendant to the festal volume presented to him on his seventieth birthday (1900), it had been proposed to commemorate his ninetieth birthday with another memorial volume containing a complete bibliography of his writings, to be followed by a selection of his best utterances, such as Camac has culled from the writings of Osler. No more fitting tribute to Jacobi's memory could now be made.

In 1873, Dr. Jacobi married Miss Mary C. Putnam, who was one of the first lady graduates in medicine (1870), and became herself a famous physician.

Dr. Jacobi was of short, slight but elastic frame, his whole person dominated by the large, splendid head, leonine, magisterial, with its crown of hair, the living embodiment of some great high-priest of knowledge of old. The earlier portraits betoken extraordinary vigor of mind and body, and even in his declining years, his cheerful tenacity of life was with him to the last. There came the inevitable lines in the face, "which years, and curious thought, and suffering give," but the expression of the wonderful eyes, subtle, humorous, pathetic, the eyes of the physician who is also philosopher, did not change. He was large-minded, big-hearted, intensely human, his conversation flavored with delightful banter, the tricksy humors of dainty Ariel or frolic Puck. With women and young people, in particular, his captivating charm of manner was unfailing. If it be true that "the old are natural enemies of the young," he was one of the delightful exceptions. With his broad background of culture, his knowledge and achievement, he had ever a delicate, ironic trait of genuine modesty, with which any reference to his own performance was inevitably tinctured, the modesty of those who, in the words of the Italian poet, "continually compare themselves, not with other men, but with their own ideal of perfection." In a private letter, he mourns "my constant routine work in daily practise for sixty years, that kept me in solitude, away from the good and great men, ever away from music and literature, and away from those who called me friend." His fidelity to duty was that of Browning's Corregidor. Yet he was a member, frequently president, of many medical societies, and a constant participant in their meetings. It is characteristic of the man that he once gravely rebuked me for disinclination to attend such meetings, although my excuse, as a non-practitioner, was perfectly valid. Characteristic also was his vein of thought, spontaneous as a flight of birds, with its omnipresent humor, a trait which made for perfect poise and sanity. His quaint remarks, at an alumni dinner, about the poultry in Lohengrin recall the well-known witticism of Lady Duckle in "Evelyn Innes." At the age of eighty-seven, he wrote:

> When old ladies believe in the efficacy of hot chamomile tea, no matter whether they mean Roman or vulgar flowers, in fever and in belly ache, you hope that not many of that class of old ladies are left. I have survived them.

As sometimes happens with those who have come to us "bringing gifts in their hands," Jacobi was, in helpful, unlifting citizenship, an inspiring example. He once said to me, very simply: "I am a Hebrew by race, but not clannish, not a sectarian." His adaptation to environment was, as in Osler's case, that of a colonial or continental American. In actuality, he belonged to the nobler ante-bellum generation which produced the "Lees, Lincolns, Shermans and Grants." The fact was written in his face. He had nothing either of the *vieux bonze* or of the smart, metallic, business manner of the *arriviste*. His civic courage was of the highest order. Not even the offer of Henoch's chair in Berlin could induce him to give up the ideals of his fiery youth, or to desert the country of his adoption, a sign that real character does not change: *Genio y figura, hasta la muerte*. One was frequently impressed with his facial likeness to the novelist Turgenieff, who, in a less personal and forthright way, was also a protagonist of civil and personal liberty, and in whom there was the same elusive irony and spontaneity of thought. One recalls the immortal words pronounced by Renan in the Gare du Nord over the bier of the great Russian, once defined as "the best that human nature is capable of":

Il fût d'une race par sa manière de sentir et de peindre; il appartenait à l'humanité tout entière par une haute philosophie, envisageant d'un œil ferme les conditions de l'existence humaine et cherchant sans parti pris à savoir la realité. Cette philosophie aboutissait chez lui à la douceur, à la joie de vivre, à la pitié, chez les créatures, pour les victimes surtout. Cette pauvre humanité, souvent aveugle assurément, mais si souvent aussi trahie par ses chefs, il l'aimait ardemment. Il applaudissait à son effort spontané vers le bien et le vrai. . . . La politique de fer qui raille ceux que souffrent n'était pas la sienne. Aucune déception ne l'arrêtait. Comme l'univers, il eût recommencé mille fois l'œuvre manquée; il savait que la justice peut attendre.[2]

As a soldier of the common good, as one to whom thousands of mothers and children in his city owe so much, it needs but the slightest alteration of the poet's lines to define what Jacobi stood for:

Duty divine and Thought with eyes of fire,
Still following Righteousness with deep desire
Shone sole and stern before him and above
Sure stars and sole to steer by; but more sweet
Shone lower the loveliest lamp for earthly feet—
The light of little children, and their love.

F. H. Garrison

Army Medical Museum

[2] E. Renan, "Adieu à Tourguénieff," October 1, 1883.

SCIENTIFIC EVENTS

THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION[1]

The second British Scientific Products Exhibition promoted by the British Science Guild was opened at the Central Hall, Westminster, on July 3, and it will remain accessible to the public until August 5. It will be remembered that the first exhibition was held in King's College last August, but owing to the arrangements of the college, due to demobilization, it was found impossible to hold the present exhibition there. Last year's exhibition was afterwards transferred to Manchester, and it proved eminently successful in carrying into the provinces a knowledge of the recent achievements of British science and industry.

This year's exhibition was declared opened by the Marquess of Crewe in the presence of a representative company of scientific and technical workers. In his opening address Lord Sydenham, who occupied the chair, referred at some length to the important part played by British science and industry in the victory which has so recently crowned the Allied efforts. We proved ourselves superior to the enemy in every technical art, and but for the splendid cooperation of the leaders of science and industry our Army would have fought in vain.

In declaring the exhibition opened the Marquess of Crewe emphasized the difference between the present exhibition and the one held at King's College last year. The latter took place at a time when the result of the war was

[1] From *Nature*.

still doubtful, although the tide of battle was flowing strongly in our favor. Necessarily, therefore, it gave precedence to industries engaged primarily in the service of war. The present exhibition, on the other hand, is meant to show the triumphs of British industry in the arts of peace, and to bring home to the general public the importance of the relationship between science and industry, and also between education and research.

In this connection Lord Crewe dwelt on the desirability of introducing definite industrial courses for university students in technology, such courses to be taken in vacations at suitable works connected with the particular study the student is undertaking. Such an arrangement has worked with great success in the United States. The institution of industrial fellowships for post-graduate students attached to one or other of the universities would also have an important influence in keeping industries in touch with modern scientific developments, and, in addition, provide the country with highly trained technologists. The Department of Scientific and Industrial Research is endeavoring to do something on these lines by urging the establishment of industrial manufacturing associations which will carry on research in some particular technical branch.

The exhibits themselves are almost bewildering in their comprehensiveness. Practically every phase of British industry is represented, the various exhibits being divided into the following eleven sections: Mechanical Science, Physics, Textiles, Electrical Appliances, Medicine and Surgery, Paper and Illustration, Agriculture, Chemistry, Aircraft, Fuels and Metallurgy.

THE BRITISH PARLIAMENT AND MEDICAL RESEARCH

The "Dogs' Protection" Bill, which was introduced by Sir Frederick Banbury and was greatly altered on report at the instance of the government, came up for third reading in the House of Commons on June 27. The third reading was formally proposed by Sir F. Banbury.

According to the report in the *British Medical Journal* Sir Watson Cheyne asked the House to say that it declined to proceed further with the measure, which would impose an unnecessary and vexatious obstacle to medical research. While recognizing the value of the amendment carried by the government as an alternative to the bill itself, he held that it introduced a very great obstacle to research. The task of getting the additional certificate which was required as the bill now stood ought not to be imposed. Another reason why he objected to the bill was that it involved a very grave censure upon a large body of honorable men and on a great profession; for this censure there was no justification. The bill in its present form implied that cruelty was being practised, and that the medical profession delighted in torture and could not be trusted to deal with animals. At one time he had certificates and licenses, and later he became one of those responsible for signing certificates. At the time that he sought licenses he found it difficult to get the second signature, and when the certificates were obtained they had to be taken to the Home Office, and used to lie there for some considerable time before they were gone through. Under the bill it was proposed to have further restrictions and another certificate, which was to be got in order to show that no other animal was possible for the experiment except a dog. It would be necessary not only to persuade the informed people but also the Home Secretary, who perhaps knew little about this particular department of science, that the experiment was necessary. Thus a very great difficulty would be added to many existing difficulties, and delay would be caused. In maintaining that the fresh restrictions were unnecessary, Sir Watson urged that those in responsible positions as to these matters lived up to their responsibility. He had known the danger of delay, and had tried to make the decision the same day; but he had more than once refused certificates, either that he thought the research was not a good one, or because he thought the man seeking to undertake it had not had sufficient preliminary education for such important work. The suggestion of

the Antivivisection Society, that the duty of deciding as to the grant of certificates was not satisfactorily discharged, was disgraceful. Sir Watson next referred to the principle arguments raised against experiments on dogs. It was said that if there was anything of value to be learned it could be obtained by observations on patients and by *post-mortem* examination. As an illustration how wrong that opinion was, Sir Watson spoke of the situation which occurred when the Germans first used gas. Personally, he was much alarmed, for if the enemy had gas enough, it seemed to him they could easily destroy whole armies. How was that risk to be dealt with? Were the authorities to sit down and wait while the doctors watched gassed men and waited for a *post-mortem* examination? Had experiments on dogs not been made much valuable time would have been wasted and many lives would have been lost. But certain experiments on animals—dogs and goats—were made and complete protection was quickly found against the gas. The history of medicine was full of instances of prolonged observations of patients and of *post-mortem* examination, without result. Yet results had been achieved almost at once by experiments on animals. In conclusion, he urged that at a time when health bills had just been placed on the Statute Book the sensible thing to do would be to sweep away restrictions instead of imposing fresh ones.

Sir Philip Magnus, in seconding the amendment, said that by the rejection of this bill Parliament would show its appreciation of the efforts that had been made by scientific men through researches to prevent and cure diseases. The bill was inconclusive and contradictory. For example, it appeared, as he read the first clause of the bill, that if some eminent surgeon desired to perform an experiment on a dog, which would relieve it of great pain and possibly save its life, he could not perform this experiment, however urgent, without a certificate from the Home Office. After further discussion in favor of and against the bill, it was defeated by a vote of 101 to 62.

A BILL FOR A NATIONAL DEPARTMENT OF HEALTH

HONORABLE JOSEPH I. FRANCE, U. S. Senator from Maryland and chairman of the Senate Committee on Public Health and National Quarantine, introduced on July 17, Senate Bill 2,507 creating a department of public health. The bill follows the general plan of the Owen Bill, with some important modifications.

According to the summary in the *Journal* of the American Medical Association it provides for a department of public health under the direction of a secretary, who shall be a member of the cabinet, and for three assistant secretaries, the first assistant to be a man trained in medical science, public health and sanitation; the second to be an expert in vital statistics, and the third to be a woman trained in medicine or nursing and public health. The U. S. Public Health Service and the Bureau of Chemistry are to be transferred to the new department, which is also to have bureaus on vital statistics, sanitation, hospitals, child and school hygiene, quarantine, food and drugs, nursing, tuberculosis and personnel. The secretary of public health is directed to communicate with the governor of each state requesting him to recommend to the legislature suitable legislation with adequate appropriations to secure cooperation between the federal department of public health and the state board of health. Every state taking such action is to be entitled to its proportionate share of such funds as may be appropriated by Congress for carrying out the provisions of the act. The secretary of public health is also directed to divide the United States into health states, districts, subdivisions and precincts, each conforming to the geographical boundaries of the various political divisions. Each state is to create a state board of health with a state health officer and a health officer for each district, subdivision and precinct, the secretary of public health to appoint these state officers as federal health officers "so that in each cooperating state every health officer of said state or of each district, county or precinct therein is by virtue of his selection by the

local authorities become also a federalized officer and as such an integral part of the Department of Public Health." The Department of Public Health is directed to cooperate with the Departments of Commerce, Labor and the Interior in the collection of vital statistics and to establish a uniform system of cards, records and reports regarding diseases, disabilities, industrial accidents, births, deaths, physical condition of school children, the number and condition of existing hospitals, etc. The bill provides for the appropriation of $15,000,000 for 1920 to be prorated among the states in proportion to their population as soon as the states comply with the provisions of the law and the regulations of the secretary of public health, provided that each cooperating state must contribute to the public health work a sum equal to that contributed by the federal government and that it must make full and complete reports of births, deaths and morbidity. It also appropriates $48,000,000 for the construction of sanatoriums and hospitals, this sum to be distributed among the states in proportion to their population, each state receiving its allotment to provide an equal amount, also location, plans and means of future support for the proposed hospital.

THE ROCKEFELLER INSTITUTE OF MEDICAL RESEARCH

THE Board of Scientific Directors of The Rockefeller Institute for Medical Research announces the following promotions and appointments:

Dr. Harold L. Amoss, hitherto an associate in pathology and bacteriology, has been made an associate member.

Dr. Oswald T. Avery, hitherto an associate in medicine, has been made an associate member.

The following have been made assistants:

Miss Clara J. Lynch (pathology and bacteriology).
Dr. Waro Nakahara (pathology and bacteriology).

The following new appointments are announced:

Dr. Homer F. Swift, associate member in medicine.
Dr. Francis G. Blake, associate in medicine.
Dr. Raymond G. Hussey, associate in pathology and bacteriology.
Dr. J. Harold Austin, assistant in medicine and assistant resident physician.
Dr. Albert H. Ebeling, assistant in experimental surgery.
Dr. Ferdinand H. Haessler, assistant in pathology and bacteriology.
Dr. Thorsten Ingvaldsen, assistant in chemistry.
Dr. Charles W. Barrier, fellow in pathology and bacteriology.
Dr. J. Jay Keegan, fellow in pathology and bacteriology.
Dr. Philip D. McMaster, fellow in pathology and bacteriology.

Dr. Alphonse R. Dochez, hitherto an associate member in medicine, has accepted an appointment as associate professor of medicine in the medical department of Johns Hopkins University.

Dr. Arthur L. Meyer, hitherto an associate in physiology and pharmacology, has accepted an appointment as associate in physiology in the school of hygiene and public health, Johns Hopkins University.

THE RAMSAY MEMORIAL

AT a meeting of subscribers of the Ramsay Memorial Fund held at University College, London, the committee submitted a report showing that £43,000 in cash was already in hand, and £70,000 was in view, so that £100,000 aimed at was within realization. The sum already collected is probably the largest which has ever been raised in honor of any man of science, however distinguished. Sir Hugh Bell explained the views of the committee with regard to the application of the money, and after hearing him the meeting agreed to the following resolution:

1. That a sum of £25,000 be definitely allotted to the senate of the University of London towards the provision of a laboratory of chemical engineering at University College, London, on the site proposed in close proximity to the existing engineering buildings.

2. That the executive committee be empowered to employ the balance of the fund already subscribed, and all future donations to be received, to the foundation of Ramsay Memorial Fellowships to the number of three or to such smaller number as they may deem expedi-

ent until the fund is sufficient for founding fellowships.

3. That if and when the amount of the fund exceeds the sum required for giving effect to resolutions (1) and (2) the division of such further sum between the augmentation of the sum allotted for the chemical engineering laboratory and the augmentation of the number of available fellowships be referred to the executive committee for decision.

SCIENTIFIC NOTES AND NEWS

DR. JOHN CAMPBELL MERRIAM, professor of paleontology and historical geology in the University of California, who has been acting chairman of the National Council of Research, was elected president of the Pacific Division of the American Association for the Advancement of Science at the Pasadena meeting.

ON the occasion of the seventieth birthday of Sir William Osler, regius professor at Oxford University and previously professor in the Johns Hopkins University, which occurred on July 12, he was presented by Sir Clifford Allbutt with a collection of essays contributed by about one hundred of his pupils and colleagues.

DR. F. G. COTTRELL, chief metallurgist of the Bureau of Mines, has been named assistant director in charge of all investigative and scientific work and J. E. Spurr, chief of investigative work in connection with relief claims has resigned to become editor of the *Engineering and Mining Journal* of New York.

AT its recent commencement the University of Maine conferred the degree of LL.D. upon Dr. Raymond Pearl, of Johns Hopkins University.

MAJOR WILLIAM BOWIE, chief of the Division of Geodesy, U. S. Coast and Geodetic Survey, received the degree of doctor of science at Trinity College, Hartford, Connecticut, on June 23, Major Bowie sailed from New York on July 5 to attend as a delegate from the United States Coast and Geodetic Survey, the conference of the International Research Council, which is being held at Brussels from July 18 to August 10.

SIR FRANCIS YOUNGHUSBAND, known for his works on Asia and Africa, has been elected president of the Royal Geographical Society to succeed Sir Thomas Holdrich.

MR. L. G. RADCLIFFE, of the Municipal College of Technology, Manchester, has been awarded the gold medal of the Worshipful Company of Dyers, London, for his researches on the sulphonation of fixed oils.

A RAMSAY Memorial Fellowship has been awarded to Elrid G. Young, M.Sc., of McGill University. These fellowships are of the value of $1,500, and are given to the students for ability in research to enable them to continue their work in one of the British universities.

IT is reported in *Nature* that in reply to a question in the House of Commons on July 8, it was stated that the appointment of Major C. E. Mendenhall, professor of physics in the University of Wisconsin, as scientific attaché to the United States Embassy has been notified to the Foreign Office by the United States Ambassador. No steps have as yet been taken to appoint a scientific attaché to Washington. The appointment of Professor Mendenhall was a war measure and it has yet to be decided whether the post will be made permanent.

CAPTAIN EBSON Y. TITUS has been appointed assistant professor of chemistry at the University of Wisconsin. Captain Titus received his doctorate at Wisconsin in 1917. Shortly thereafter he entered military service and became gas officer of the Sixth Division in France. In November, 1918, he returned to the United States and was detailed to the Ordnance Department and was made chief chemist for Nitrate Plant No. 1 at Sheffield, Alabama.

DR. ISAAC F. HARRIS, head of the department of biochemistry of E. R. Squibb and Sons, has moved from the laboratories at New Brunswick, New Jersey, to the offices of this company in New York. During the last years of the war, Dr. Harris constructed and equipped a factory at New Brunswick for the manufacture of the chlorinated derivatives of toluol-chloramine-T and dichloramine-T, which were

so extensively employed as antiseptics by the allied forces, according to the methods of Drs. Alexis Carrel and H. D. Dakin.

Dr. Austin M. Patterson, who for the past fourteen months has been connected with the editorial section of the American University Experiment Station, Chemical Warfare Service, has returned to his home at Xenia, Ohio.

Lieutenant Colonel John Amyot, professor of hygiene and preventive medicine in the University of Toronto, who has been overseas for three or four years as sanitary officer to one of the Canadian divisions, has been appointed deputy minister of the newly created federal department of public health at Ottawa.

Professor Woolnough has been granted five months' leave of absence by the senate of the Western Australian University to visit England and place the claims of the western state before Messrs. Brunner, Mond, and Co., as the most suitable site in Australia upon which to establish the alkali industry.

Dr. S. Burt Wolbach, of Harvard University, who has been in Mexico to make certain studies on typhus fever, has returned to the United States.

T. D. Beckwith, professor of bacteriology at the Oregon Agricultural College, has been granted a leave of absence for one year. He expects to study at the University of California.

Dr. Edward Cowles, a distinguished chemist, long superintendent of the McLean Hospital and professor of mental diseases in the Dartmouth Medical School, died at Plymouth, on June 25, in his eighty-third year.

Adrian J. Brown, professor of the fermentation industries at the University of Birmingham, known for his contributions to biological chemistry especially in its applications to brewing, died on July 2, at the age of sixty-six years.

Sir William McGregor, a well known English colonial governor, who made important contributions to ethnology when stationed at New Guinea, has died at the age of seventy-two years.

Dr. Nikolas Berend, a member of the faculty of the University of Budapest and widely known as an authority on children's diseases, was killed recently during an attempt to overthrow the Soviet government in Budapest.

The first National Congress of the Manufacturing Chemists of Italy is to convene at Milan in October with an exhibition annex.

The London *Times* states that members of the International Hydrographic Conference visited the Admiralty Compass Department at Ditton Park, Datchet, where all work connected with the receipt, issue and testing, etc., of compasses, both magnetic and gyroscopic, for the Navy and Air Force is carried out at the Observatory, and branches have recently been formed for experiments and research work on compasses and optical instruments. The guests were received by Captain Creagh Osborne, director of the observatory, and after luncheon split up into parties and members of the staff explained the instruments and their utility. During the war as many as 1,500 aeroplane compasses have been turned out in a week at the observatory, and at times as many as 7,000 have been received from oversea and from the country for repair.

Nature states that having held its meetings at Taunton during the period of the war, the Somersetshire Archeological and Natural History Society had hoped to hold its seventy-first annual meeting and excursions away from headquarters, but this has been found impossible owing to the difficulty of hotel accommodation. However, long excursions will be taken into Devon on this occasion, viz., to Hembury Fort, Cadhay House (1545–87), and Ottery St. Mary Church on July 30, and to Exeter on July 31. The annual meeting will be held at Taunton on July 29 under the presidency of Mr. Henry Balfour, curator of the Pitt Rivers Museum at Oxford, and past-president of the Royal Anthropological Institute. The subject of his presidential address was "The doctrines of General Pitt Rivers and their influence." The society now consists of between 900 and 1,000 members, and owns a

large library and the Somerset County Museum at Taunton Castle.

The psychological laboratory of the Johns Hopkins University has been granted the sum of $6,000 "for investigating the informational and educative effect upon the public of certain motion picture films used in various campaigns for the control, repression and elimination of venereal disease."

To increase its capacity for the production of anti-pneumonia serum, the laboratory in charge of Dr. Preston Kyes, professor of preventive medicine at the University of Chicago, is to be enlarged at a cost of five thousand dollars.

Through the generosity of Colonel Walter Scott, of New York, the library of the department of zoology at Smith College has received a complete set of the great Belgium entomological work Wytsman's "Genera Insectorum."

Dr. William Allen Sturge bequeathed his large collection of prehistoric objects of stone, bone and horn to the British Museum.

Nature states that it is proposed to establish an institute of commercial and industrial psychology and physiology. The announcement is accompanied by a summary of thirty investigations in which the scientific analysis of industrial movements resulted in a notable improvement of output, and reference is also made to the effects of shorter hours and the introduction of rest pauses. Amongst the scientific supporters of the proposals are Sir Walter Fletcher, Mr. W. B. Hardy, Lieutenant Colonel Myers, Professor C. S. Sherrington and Professor E. H. Starling. The secretary is Mr. G. Spiller, 1 Great Tower Street, E.C.3.

The Geological Survey, of Ottawa, Canada, has sent an expedition to Graham Island, of the Queen Charlotte group in British Columbia, off the west coast of Canada. Mr. Clyde L. Patch is studying and collecting mammals and birds and is giving special attention to the herpetology of the regions. Mr. Harlan I. Smith is continuing his researches into the archeology of the North Pacific coast of America which he began in 1897 on the Jesup North Pacific expedition by exploration and excavation in this part of the Haida linguistic area. The Haida were undoubtedly the most noted people and most feared warriors of the Pacific coast of North America. They were unsurpassed as canoe builders, carvers and painters. They were noted for their great potlatches and other financial and social customs. Yet the archeology of the Haida area is practically unknown, no intensive exploration or excavation of prehistoric sites having been made in their historic habitat.

"To stimulate interest, promote study and facilitate publication of researches in agricultural history" is the object of the Agricultural History Society which has been organized in Washington. It plans to present in permanent form the history of one of the biggest constructive factors in the history of the United States —agriculture—and the influence it has exercised in making this country what it is. The officers are: *President*—Dr. Rodney H. True, Bureau of Plant Industry, Washington, D. C.; *Vice-president*—Professor Wm. J. Trimble, Agricultural College, North Dakota; *Secretary-treasurer*—Lyman Carrier, Bureau of Plant Industry, Washington, D. C.; *Members of Executive Committee*—Professor R. W. Kelsey, Haverford, Pa., and O. C. Stine, Office of Farm Management, Washington, D. C. Interested persons who pay the dues of one dollar a year are eligible to membership.

A large herd of American buffalo has been purchased by William Clayton, of Wyoming, from W. D. Turner, of Colorado. The herd contains about 225 animals and sold for approximately $40,000. It is the intention of the purchaser to dispose of the buffalo in small groups to public parks and zoological gardens. The herd was started by General Palmer of Colorado Springs, Colorado, who desired to preserve a representative collection of the animals. Mr. Turner later secured the original herd and improved it by introducing new blood from Canadian herds.

The annual report of the Lister Institute of Preventive Medicine (the name is to be changed to the Lister Institute of Medical Re-

search), was recently issued. The London *Times* states that the institute at the outbreak of war emphasized to the War Office the paramount need of tetanus antitoxin, and on its own initiative took steps immediately to enlarge the capacities of its therapeutic farm at Elstree, where horses were kept for the purpose of producing the antitoxin. In consequence the needs of the soldiers were met and thousands of lives saved. The institute also carried out researches on the antitoxin, and on various other sera and antitoxins. The Trench Fever Committee, of which Sir David Bruce is chairman, owed very much to the help of the institute and, indeed, could not have carried its researches to their brilliant conclusion without that help. Investigations arising out of the outbreak of food poisoning in the Army in France were also carried on, and various other work in connection with food undertaken, more especially that dealing with what are called "accessory food factors." Scurvy, for example, which was one of the great problems among troops in Mesopotamia, arose from the absence of one of these factors in the ration. The researches of the institute enabled the fact to be established, and suggested the remedy. Causes and remedies similar in kind, though differing in particulars, have been investigated for infantile scurvy. Other researches are now proceeding in respect of the indispensable food factors in milk, butter, margarine and so on.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of Charles N. Clark, former treasurer and trustee of Smith College, practically his entire estate, estimated at $500,000, is bequeathed to Smith and Mount Holyoke colleges.

AT the University of Michigan salaries have recently been increased 30 per cent. for instructors and assistant professors and 25 per cent. for associate professors and full professors. The new scale of salaries is from $1.300 to $2,100 for instructors, $2.200 to $2,600 for assistant professors, from $2,700 to $3,100 for associate professors and from $3,200 to $6,000 for full professors. The same scale applies to all colleges.

A COMPETITIVE examination to fill four vacancies in the grade of instructor in mathematics will be held at the Naval Academy, Annapolis, Maryland, on August 27. The base pay is $2,000. Particulars as to the qualifications can be obtained from the head of the department.

DR. H. A. MORGAN, dean of the Tennessee State College of Agriculture, has been elected president of the University of Tennessee.

DR. JOHN C. HESSLER, professor of chemistry, has been appointed acting president of the James Millikan University at Decatur, Illinois.

DR. ROLLIN D. SALISBURY, professor of geographic geology and head of the department of geography at the University of Chicago, has been appointed head of the department of geology and paleontology to succeed Professor Thomas C. Chamberlin, who has retired from active service. Professor Harlan H. Barrows has been given the chairmanship of the department of geography made vacant by the transfer of Professor Salisbury. The latter still remains dean of the Ogden Graduate School of Science. Dr. Edson Sunderland Bastin, of the United States Geological Survey, has been appointed to a professorship of economic geology, from January 1, 1920. Dr. Bastin received his doctor's degree from the University of Chicago in 1909. Other new appointments are those of Russell Stafford Knappen to an instructorship in geology, and of Derwent Stainthorpe Whittlesey to an instructorship in geography.

DR. RICHARD WRENSHALL, a graduate of Yale University, has joined the faculty of the College of Hawaii, as professor of chemistry.

THE following appointments have been made at the University of Birmingham: John Robertson as professor of hygiene and public health; John Shaw Dunn as professor of pathology; Leonard Gamgee as professor of surgery; B. T. Rose, demonstrator of anatomy, and Miss Hilda Walker, lecturer in physiology.

DISCUSSION AND CORRESPONDENCE

LABORATORY INSTRUCTION IN CHEMISTRY; ITS AIMS AND ITS LIMITATIONS

It is now well over half a century since the laboratory has been regarded as a necessary feature in the study of science—elementary as well as advanced. Before that laboratory methods of instruction were rarely practised and were available only for the exceptionally fortunate, or probably exceptionally able, student who had first demonstrated in a purely intellectual way his aptitude for science.

The greatness of the achievement of the brilliant scientific men before, say the middle of the nineteenth century, with poor facilities for work, and inadequate knowledge upon which to build, certainly furnishes an argument that intellect may be stimulated rather than discouraged by lack of practical facilities.

The question must present itself to every one connected with training students in scientific schools, to what extent expensive laboratory facilities are justified, particularly for the great numbers of elementary students, when compared with the results achieved. No one will argue that direct observation of scientific phenomena in experiments performed with the student's own hands does not increase the student's familiarity with the phenomena. Perhaps we might say that the impression made upon the student's mind by a personally performed experiment is so much more vivid than the impression made by a written statement in a text-book, or even by an experiment performed by the professor on the lecture table, that the phenomenon is remembered with much less intellectual effort. Since however progress is attained only through the expenditure of effort, we may well ask, will the student of science reach as high a plane of intellectual development if the laboratory is used too freely for demonstration purposes.

The writer acknowledges as the immediate stimulus to present these thoughts, the article in SCIENCE of May 30, 1919 (page 506) upon "The Freas System," written by Dr. W. L. Estabrooke.

The Freas System is obviously a recognition of the problem of balancing the costs of laboratory instruction against the results. It is to be hoped that further details of this system promised by the writer will bring its advantages fully to the knowledge of those who have the administration of the laboratories of our schools and colleges. Certain rather broad aspects of the question are suggested by the first article and it is to be hoped that they will be discussed by the advocate of the Freas System.

The Freas System seems to be a species of modern factory efficiency management applied to laboratory administration. There can be no doubt that all possible efficiency in obtaining, distributing and conserving laboratory supplies and apparatus is to be desired, nor is there any doubt that without careful planning and a capable administrator in charge the efficiency will be low. But how far will the enthusiasm for efficiency in handling supplies tend to reduce the instruction to a lifeless routine. It would almost seem as if in the Freas plan the structure of the laboratory course had been built around the framework of the system of supply distribution. For we are told that at the beginning of a term the student receives supplies exactly sufficient for a whole term's work in a carefully planned kit. Such a kit contains for some of the courses as many as 140 different bottles of materials.

Modern American factory methods are marvelous when measured by the material output, but they do not rank so high when measured in terms of the welfare of the individual worker. Perhaps the solution of the factory-labor problem will recognize that the welfare and happiness of the individual workers is the framework around which the structure of industry must be built. No educator thinks other than that intellectual development is the aim to which educational effort must be directed. The writer does not see how a standardized routine of laboratory experiments can stimulate the intellectual development of a student any more than the intensive drive of production in a textile mill can stimulate the joy of life in the worker standing day after day in the same place over noisy looms.

The primary purpose of the experimental laboratory was to carry out original investigations. It is well not to lose sight of the fact that the laboratory of elementary chemistry can appear to the beginning student a place of original investigation. Indeed it is probably safe to say that the amount of intellectual stimulus he receives in the laboratory is in direct proportion to the extent to which he takes the attitude of an investigator.

It is more often the case than not that after a student has performed a routine experiment in a routine manner, he will retain of it so vague a recollection that he will be unable to relate his observations the next day in the class room. When however the experiment has developed some unexpected feature which perplexes him enough to incite him to try out variations of the experiment upon his own initiative, he will be found full of information and argument in the class room.

Elementary experiments may be classified into two kinds: (1) isolated short experiments, and (2) sustained experiments. The short experiments may be planned in a beautiful sequence, each building on the results of the preceding ones in a manner to arouse the admiration of an instructor. Yet to the student they seem just isolated experiments and he is only too likely to receive the impression that the standard of his work is measured by the number performed. Even when the student is above the average of intelligence and sees pretty clearly the sequence as planned by the instructor, he still does not develop very much enthusiasm for a thing which has been all planned out for him.

(2) The type of experiment referred to as sustained is illustrated by the "unknowns" of qualitative analysis, and by chemical preparations. In each of these cases there is a definite objective set to work toward, the work is prolonged enough to awake a sustained interest, and there is a tangible result obtained when the experiment is finished. Moreover, the manipulations require judgment and develop incidental problems not foreseen in the directions.

The writer believes that efficiency methods which increase the output of material products of an industry are not directly applicable to the development of intelligence. True, the Freas method may double the number of experiments which the student will perform in a laboratory period. But can we measure the development of the student by the number of experiments performed any more than we can measure the happiness of the mill operative by the number of yards of fabric which he can get through his looms in a day.

Scientific research is in its nature inefficient if judged in terms of the formulas of production experts. Yet research is recognized by large industries as a vital part of their organization.

The value of laboratory work depends mostly on the extent to which the students feel the research spirit—even if in but a very feeble way in elementary laboratories. The acquiring of manipulative skill and the learning of properties which are better stated in the textbooks than they can be observed by the student, are for the most part incidental to the more important purposes. To encourage this spirit of research, reagents must be available on the side shelves for free use within reasonable bounds. In fact a well-stocked outfit of reagent shelves serves as a chemical museum and time spent in going to these shelves, inspecting the chemicals there, and sometimes in trying out reactions not specified in the directions, is surely not time wasted. Naturally the student should be expected to work industriously during laboratory time and he should perhaps be expected to perform at least a certain minimum number of "required" experiments. But he should not be continually driven to realize the highest value of the ratio of experiments done to length of laboratory period. He should rather be distinctly encouraged to work thoughtfully and be made to feel that quality is given more recognition than mere quantity.

At all events there must be a compromise in elementary laboratories handling large classes, between efficiency of the supply service on the one hand, and the scientific inspiration to the

individual student on the other hand. It is hard to see how cut and dried laboratory experiments, with all materials measured out in advance ready to be put together, can interest an intelligent student so much as experiments performed on the lecture table.

The writer realizes that many will deem him guilty of heresy even for putting the question: Do we give too much laboratory work in our science courses? If it becomes necessary on account of expense to so standardize the laboratory work that it loses nearly all its stimulus, were it not better to omit laboratory from the program until at least the point is reached where experiments described earlier as of the sustained type apply?

Some students are at school or college for a general liberal education—not to specialize in science. How shall they be treated if they elect to study the elements of chemistry? Is the expense of even a standardized and denatured laboratory course justified? When chemistry is chosen mainly for the object of intellectual development does not the class room work without the laboratory serve the purpose? Indeed does it not require a higher order of intelligence to visualize a chemical phenomenon from a text-book statement alone, than from a laboratory demonstration?

The writer has ventured to raise questions in the foregoing some of which have an obvious answer, others of which have been viewed for more than a generation in a uniform dogmatic manner, but ought now to be reopened and reconsidered on their real merits. The Freas System involves these questions, and it constitutes a compromise between two unreconcilable conditions. So far as the evidence presented in the article referred to goes, it seems like the case in which the compromise was effected by one party acceding to all the demands of the other. However, a misconception may have been gained from the first article of the series and the other numbers should be awaited with interest.

Furthermore, if an issue seems capable of adjustment only through an unsatisfactory compromise, is it not the part of wisdom to reexamine the conditions underlying the issue to see if perhaps the issue itself ought not be reconstructed in such a manner as to avoid the necessity of a compromise.

Arthur A. Blanchard
Massachusetts Institute of Technology

METEOROLOGY AND THE TRANS-ATLANTIC FLIGHT

Within the past few months many millions of people have had their attention directed, as never before, to the importance of meteorological conditions in connection with the question of trans-Atlantic flight. A popular interest has thus been aroused which has been but partially satisfied by the often contradictory and usually rather meager information supplied by the daily newspapers. Many persons doubtless have a real desire to inform themselves more fully in regard to the weather conditions which are likely to be met with at various altitudes over the North Atlantic Ocean. A recent paper on "Trans-Atlantic Flight from the Meteorologists' Point of View"[1] brings together, in compact form, just the sort of information of which the intelligent public is in search. The author, Willis R. Gregg, of the Weather Bureau, was actively concerned as a meteorological expert in connection with the flight of the U. S. Navy planes. The fact that Mr. Gregg's article was in print before the recent trans-Atlantic flights were accomplished does not in any way detract from its interest or value.

Mr. Gregg's chief conclusions are as follows: Favorable conditions of wind and weather are necessary for the safety of airplanes which attempt the trans-Atlantic flight. In order to obtain the requisite knowledge of the prevailing atmospheric conditions, frequent and widely-distributed observations are necessary. When a favorable day comes, the meteorological expert can indicate the successive directions toward which the airplane should be headed in order to keep to any desired course, and can also calculate the assistance which the winds will furnish. Favorable conditions for an eastward crossing are found at 500–1,000

[1] *Mo. Wea. Rev.*, Vol. 47, 1919, pp. 65–75.

meters during about one third of the time. The percentage of favorable days increases materially at greater altitudes, especially along the northern route. The percentage of favorable days for the westward trip "is so small as to make trans-Atlantic flight in this direction impracticable until the cruising radius of aircraft is increased to such an extent that they are relatively independent of weather conditions."

As to the season, there is little choice. The prevailing westerly winds are stronger in winter than in summer, but there are more storms in the colder months. The greater prevalence of fog in summer is a disadvantage at that season which about offsets the greater amount of cloudiness in winter. The fogs of Newfoundland are generally of but slight vertical extent, and as they do not extend far inland they ought not to interfere with a landing if such is attempted some distance from the coast. The most important thing of all is the need of a comprehensive campaign to secure meteorological and aerological observations over the North Atlantic.

R. DeC. Ward

QUOTATIONS

BRITISH SCIENCE AND INDUSTRY

The speakers at the opening of the British Scientific Products Exhibition emphasized different aspects of the same truths. When the war came, England was deprived of many scientific products which she had been content to receive from Germany. English scientific men and inventors had long been in the forefront of discovery, but English manufacturers had taken little advantage of their achievements. We had not the industrial processes for making high explosives from coal-tar nor the methods of making optical glass for gun-sights. In a thousand ways, great and small, we were unready for the ordeal. The unlimited valor of our fighting men and the unswerving resolution of the people alone carried us over the dead point. The exhibition of British scientific products, made in Britain, for the first time during the war, shows the splendid progeny of the *liaison de convenance* hurriedly arranged between science and industry. It is to be hoped that it will lead to a more permanent union.

The war is over, and there is more than a fear that the soporific effect of the cry "Business as usual" may again be felt. Business will not be as usual. The old British way of being content with large-scale manufacture of the "good enough," of seeking the easy market and the repeat order, is gone for ever. Even the best is not good enough, for there is always a better. As Lord Moulton said, Divine discontent must have its place in our industries. The manufacturer must keep in touch with the inventor and the scientific student. The men of the laboratory must keep aware of the industrial processes to which they can so largely contribute. The seller of British goods must have a better weapon than blandishment; he must be able to explain why his goods are the best, and to stimulate the imagination of his customers by the assurance of better. Lord Crewe rightly laid stress on the part of education in the new orientation of our scientific and industrial effort. He referred with legitimate pride to the associations of manufacturers and investigators that are being organized by the Council of Scientific and Industrial Research. But there is still a long way to go. In one sense, the lean years that lie ahead of us are less favorable to continued effort, although they require it even more urgently. During the war an imperative stimulus quickened our common purpose. Money flowed like water for the experiments of the laboratory and the workshop, and the operations of war supplied the swiftest and surest test of efficiency. We must lose none of the organizing and self-sacrificing spirit that we gained when our need seemed greatest.—The London *Times*.

SCIENTIFIC BOOKS

The Turtles of New England. By Harold L. Babcock, M.D. Mem. Boston Soc. Natural History, VIIII., No. 3, 4to, pp. 325 to 431, plates 17 to 32, April, 1919.

This is the most recent of the series of monographs of small groups of vertebrate animals issued by the Boston Society of Natural History from time to time. The seventeen species of turtles recorded as native to New England are taken up in order and described, size, color, form, distribution, numbers, breeding, food, enemies, economic importance. The plates comprise careful color drawings by R. Decker and J. Henry Blake, of all but the marine leather-back, loggerhead and green turtles, and photographs of these three. The illustrations facilitate the identification of the different turtles, supply the best existing figures of certain comparatively little-known species and, as representative of New England material, will be valuable for reference to faunal herpetologists. There are several pages of bibliography of references cited. Of the seventeen species of turtles treated, four are marine, one littoral, one almost strictly terrestrial, one strictly aquatic, and ten more or less amphibious. Exclusive of the marine species, six are rare or local in New England, the remaining seven being the snapping turtle, musk turtle, painted turtle, diamond-backed terrapin, spotted turtle, wood tortoise and box tortoise.

This publication will be welcomed by the students of the fauna of New England and herpetologists in general, but it should have a much wider circulation. Ability to refer to it will add to the pleasure which every New England child may be expected to find in turtles. The turtle is one of the most striking of nature's phenomena and the correlation of its remarkable structure with its habits has much popular interest. A careful consideration of the life-histories of the different species is a feature of Dr. Babcock's work. From the quotations it is noticeable how many interesting things about turtles have only recently come to light and we are impressed with the probability that others as interesting remain to be found out.

In conclusion, a word should be said of the thorough investigation of the New England fauna by the Boston Society of Natural History of which this paper is a detail. Larger institutions are often absorbed by distant problems and work of this nature is much needed to keep the study of natural history well balanced.

J. T. Nichols

American Museum of Natural History

SPECIAL ARTICLES

THE FUNGUS PARASITE OF THE PERIODICAL CICADA

The fungus *Massospora cicadina*, Peck has been extremely prevalent about Washington, D. C., during the recent reappearance of Brood X of *Cicada septendecim*. It was first collected in the conidial stage of development on May 31, or about ten days after the first emergence of the insect in this locality. Until June 7, however, it was not abundant, it being possible to collect only a dozen or so infected cicadas in an afternoon, and during this period only the conidial stage of the fungus was found. On June 10, however, following a wet period of a few days, the organism appeared in the resting spore condition and since this date has become increasingly prevalent until, at the present time, from five to nine out of every ten live adult males collected will show the resting spores of the fungus in some stage of development. On the other hand, infected insects showing conidia are rarely found now.

It appears from the observations made thus far that conidia and resting spores of *Massospora cicadina* are not formed simultaneously in the same insect, and infected individuals bearing only conidia of the fungus present a somewhat different gross appearance from those insects in which resting spores exclusively are produced.

In the conidial stage of development the fungus is usually exposed to view, due to the sloughing off of several of the posterior abdominal segments of the host's body, as a white or pale cream colored more or less coherent mass which is found to arise in the male hosts at least from a cushion-like substratum, the latter forming a more or less complete septum extending across the entire

body cavity. Anterior to this septum the abdominal cavity is entirely empty.

In the resting spore condition the fungus mass, in the males, in the early stages at least, likewise confined to the posterior portion of the abdomen, is at first white, then sulphur yellow and finally greenish brown or brown in color, and only slightly coherent. While the fungus in this stage of development seems likewise to be confined to the genitalia of the host, there is apparently no septum formed, and at maturity the resting spores, scatter about the entire body cavity. The resting spores, which are extremely uniform in size, are remarkably ornamented and at maturity form a dustlike mass which is freed from the insect by the disintegration of the intersegmental membranes of the abdomen.

In the few infected females that the writer has examined the fungus mass fills nearly the entire body cavity.

As noted by previous writers, many infected cicadas were found still alive and actively flying about with but a portion of the abdomen remaining, the entire posterior portion having sloughed off leaving the conidia or resting spores of the fungus exposed in such a way that every movement of the host served to scatter them.

It is hoped that a full account of the life history of this fungus will be published soon.

A. T. SPEARE

BUREAU OF ENTOMOLOGY,
WASHINGTON, D. C.

THE OHIO ACADEMY OF SCIENCE

THE twenty-ninth annual meeting of the Ohio Academy of Science was held at Ohio State University, Columbus, May 29 to 31, 1919, under the presidency of Professor Maynard M. Metcalf. Seventy-nine members were registered as present; forty new members were elected.

The academy formally recognized the establishment of a new section for Psychology, with an initial membership of about twenty.

It was reported by the trustees of the Research Fund that Mr. Emerson McMillin, of New York City, had made a further contribution of two hundred and fifty dollars in support of research work by the academy.

At the close of the formal session, the geologists, under the leadership of Professors J. E. Hyde and T. M. Hills, made an excursion to Newark for the study of glacial physiography and the Upper Waverly formation, while Professor W. M. Barrows conducted a zoological and botanical excursion to Sugar Grove.

Officers were elected as follows: *President*, F. C. Blake, Ohio State University; *Vice-presidents: Zoology*, F. H. Herrick, Western Reserve University; *Botany*, A. B. Plowman, Municipal University of Akron; *Geology*, J. E. Hyde, Western Reserve University; *Physics*, M. E. Graber, Heidelberg University; *Medical Sciences*, R. J. Seymour, Ohio State University; *Psychology*, G. R. Wells, Ohio Wesleyan University; *Secretary*, E. L. Rice, Ohio Wesleyan University; *Treasurer*, W. J. Kostir, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

The scientific spirit: PROFESSOR MAYNARD M. METCALF, printed in SCIENCE for June 13, 1919.

PUBLIC LECTURE

Airplanes, present and future: MR. DAVID CARROLL CHURCHILL, Oberlin.

PAPERS

The theory of chance applied to the Bacon-Shakespeare controversy: T. C. MENDENHALL.

Teleology in the teaching of zoology: W. M. BARROWS.

Dynamics and evolution as illustrated in the euglenoids: L. B. WALTON.

Notes on a technique for the study of Euglenidæ: W. J. KOSTIR.

The comparative resistance of different species of Euglenidæ to acids: W. J. KOSTIR.

Notes on a tingid destructive to beans: HERBERT OSBORN.

The European corn borer (Pyrausta nubilalis Hubn) a menace to American agriculture: E. C. COTTON.

The stratification of spiders in meadows: W. M. BARROWS.

Concerning the attachment of larval colonies of Pectinatella and Plumatella: STEPHEN R. WILLIAMS.

Remarks on the phylum Prosopygia: RAYMOND C. OSBURN.

The bryozoan fauna of Greenland: RAYMOND C. OSBURN.

Classification of the Salpidæ: MAYNARD M. METCALF.

The remarkable fauna of a drop of pond water: W. J. KOSTIR.

Polymorphism and allelomorphism in Bruchus quadrimaculatus: J. K. BREITENBECHER.

Circulation of cœlomic fluid in a nematode: F. H. KRECKER.

Egg laying of a leech, Piscicola: F. H. KRECKER.

The columella auris of the reptiles: EDWARD L. RICE.

Information wanted in zoological and botanical cases to be cited: Katharine D. Sharp.
Use of airplane in studying vegetation: Paul B. Sears.
A map of Ohio prairies: P. B. Sears.
Brief notes on some Ohio plants: L. S. Hopkins.
A remarkable bud sport of Pandanus: John H. Schaffner.
The nature of dieciousness in the hemp: John H. Schaffner.
Xenia in maize and rye: A. E. Waller.
Some biological relations of the Hysteriales: Bruce Fink.
A hitherto undescribed ascomycete: Freda Detmers.
Witches broom of bald cypress: Freda Detmers.
Abscission of Populus deltoides (common cottonwood): Lois Lampe, introduced by Freda Detmers.
Toxic and antagonistic effects of salts on yeast (Saccharomyces ellipsoideus): Swarna K. Mitra, introduced by E. N. Transeau.
Two serious diseases of wheat new to America: W. G. Stover.
Estimates on the thickness of the sedimentary rocks of Ohio: T. M. Hills.
Some geological features in the Akron region: G. F. Lamb.
Some future industrial centers in America as seen by a geographer: Geo. D. Hubbard.
The location of the barrier between the Ohio and Mississippi Valley basins in Richmond times: August Foerste.
Some aspects of the Waverly: J. E. Hyde.
The pyrite deposits in the Ohio coals: W. M. Tucker.
The correlation of Ohio Silurian strata with those of Indiana: August Foerste.
Elongation of nickel in transverse magnetic fields: H. A. Bender.
The prevention and treatment of pneumonia: E. F. McCampbell.
Recent advances in the auditory method of measuring blood pressure: Clyde Brooks.
Vaccines and serums in coccus infections: C. B. Morrey.
Five years of progress in medical entomology: Edna Mosher.
A note on the technic of smear preparations: F. L. Landacre.
Differentiation of mucous and serous cells: Eva Campbell, introduced by F. L. Landacre.
Note on the effect of dry heat upon the blood of Guinea pigs: Jonathan Forman.
Observations upon the complement content of the blood of guinea pigs which have been subjected to dry heat: Carl H. Spohr.
Observations on the death of guinea pigs induced by dry heat: Ernest Scott.
A model illustrating some features of urinary secretion: Martin H. Fischer.
The muscle-twitch curve: E. P. Durrant.
Vitamine tests with chicks: R. J. Seymour and E. P. Durrant.
An anomalous frog heart: E. P. Durrant.
A modified Waterhouse test for pure butter: Chas. P. Fox.
Demonstration of Mendel's law: W. M. Barrows.
Observations on the diagnosis of contagious abortion by guinea pig inoculation: W. A. Starin.
Fat absorption in earthworm, salamander and frog: Chas. G. Rogers.
The nature of the lyophilic colloids and their importance in theoretical and applied science: Martin H. Fischer.
The normality vs. the psychopathy of the precocious child: Florence Mateer.
The clinical function of psychology: Florence Mateer.
Short methods of individual examination used by psychologists in the army: James W. Bridges.
Psychological study of a delinquent: Louise Wood.
The very bright child: C. Thompson Jones.
The moral and religious psychology of late senescence: T. Bruce Birch.
Psychology applied to the problems of everyday life: A. W. Trettien.
The vocality of fork, violin and piano tones: Esther Gatewood.
Relations of images in recall to directly aroused sensations: A. Sophie Rogers.

DEMONSTRATIONS

A case of apparent triple superfetation in the cat: R. A. Budington.
Growths on glass slides submerged in open sea water ten days: R. A. Budington.
Exhibit of Ohio Cicadellidæ: Herbert Osborn.
Indications of circulation of cœlomic fluid shown by preserved nematodes: F. H. Krecker.
Model of nasal region of the lizard, Eumeces: Elva Pumphrey, introduced by Edward L. Rice.
Sections of columella auris of the lizard, Eumeces: Edward L. Rice.
A hitherto undescribed ascomycete: Freda Detmers.
Auditory method of measuring blood pressure: Clyde Brooks.
Technic of smear preparations: F. L. Landacre.
Model illustrating some features of urinary secretion: Martin H. Fischer.
A new muscle lever: E. P. Durrant.
An adjustable spring-myograph: E. P. Durrant.
An anomalous frog heart: E. P. Durrant.

Edward L. Rice
Secretary

Delaware, Ohio

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PROBLEMS OF POPULATION OF THE NORTH PACIFIC AREA AS DEPENDENT UPON THE BIOLOGY, THE OCEANOGRAPHY, AND THE METEOROLOGY OF THE AREA[1]

For long ages before written records began, human migrations seem to have taken place over the vast Pacific region. These apparently affected the islands of the south, those of the north, and those of the the middle portions, as likewise the continental littorals of Asia and North America. Later came the era, very recent as all human history goes, of the drifting of Chinese and Japanese fishing junks upon the northern American coast, and of castaway Japanese traders upon the Mexican coast. Following this came the truly modern era, ushered in, one may fairly say, by President Fillmore's appeal to the Emperor of Japan, through the Perry embassy, for the opening up of the Hermit Kingdom in the interest of American industrial and commercial development as represented by the whale fishery, and closely identified with gold mining in California. Shortly thereafter, followed the bringing of Chinese coolies for labor in building the Pacific end of the first transcontinental railroad.

Through all these, and many other events of similar import, on down to this very summer of 1919, when hardly a day passes in which the newspapers do not contain items of some sort involving the activities of Japanese or Chinese in the industrial and commercial life of Pacific North America, can be seen a contact of Asiatics and Americans—a kind of community of interests—made not only pos-

[1] The opening paper of a symposium on "The exploration of the North Pacific Ocean," held at the Pasadena meeting, Pacific Division, American Association for the Advancement of Science, June 19, 1919.

sible, but seemingly inevitable, by their common possession of the great ocean, and of the human propensities for adventure, travel and gain.

In another connection I have called attention to the variety of meanings which naturally attach to such phrases as "The Problem of the Pacific," "The New Pacific," etc.[2]

The wording of the topic, assigned to me in this symposium, when read in the light of the above reflections and along with the other topics of the program, suggests the direction my remarks should take. To the eyes of science, the situation as touching the peoples of the north Pacific area is this: Some 500,000,000 Asiatics are being brought into ever closer contact with some 6,000,000 Americans, the Asiatics being so placed geographically that scores of millions of them have about the lowest per capita allotment of any peoples on the earth of some of the primary material necessities of human life, while the Americans are so placed as to give them about the highest of such allotment.

That economic equilibrium will tend to establish itself between these two peoples is as certain as that two bodies of salt water of different density will tend to come to an equilibrium if in contact with each other.

There are two ways in which this equilibrating tendency may work itself out. (1) It may proceed in accordance with the brute instincts of self-preservation and self-realization. This is the way of material force working as modern commercialism and modern militarism. Frequently as the resemblance between these two gigantic forces has been noticed, it yet seems not to have been sufficiently brought home to many of us. (2) The other way in which the equilibrating tendency may realize itself is in accordance with the human reason for self-preservation and self-realization. This is the way of modern intelligence and rationality; in other words, of modern science.

Perhaps some one will question the warrantableness of including all the Chinese, Japanese and Koreans, as I did a moment ago, when speaking of Asiatic populations, while only the small portion of all North Americans are included which live on the Pacific slope. If question of this sort be raised, my reply is that being naturalists, we are bound to think in terms of nature—especially of geography—whenever we speak comprehensively of people; and hence must look at population in relation to the continental slopes, drainage areas, oceanic and fluviatile waterways, etc., which constitute their major physical environments. The "North Pacific area" is clear enough of definition geographically viewed: It includes not merely the great north ocean itself, with its islands, but also those parts of the adjacent continents, Asia and North America, whose rivers flow into the ocean. In an important sense this is a unit area of populational distribution as it is of physical geography.[3]

Pacific North America, as thus defined, seems to be as natural a depositing ground for immigrants from eastern Asia as Atlantic North America is for immigrants from Europe. While manifestly it would be easy to push such a criterion of unit area of peoples too far, yet recognition of it to the extent of its validity is of great practical importance.

The fundamental nature of the issue between Asiatics and Americans is clearly reflected in the character of the American legislative measures which have been proposed, and in some instances made into law, against the immigration of Asiatics.

That the issue is not primarily one of race

[2] "The Problem of the Pacific," Bull. No. 8, Scripps Institution for Biological Research, University of California, June 14, 1919.

[3] In *Fundamental Geological Problems of the North Pacific Ocean Region*, contributed to the symposium by George D. Louderback, occurs this: "The contrast between the geologic and geographic conditions of the eastern states and of the Pacific states of the United States is marked, and their geologic history is to a considerable extent unrelated, while there are striking similarities between the conditions obtaining along the eastern and western coasts of the North Pacific Ocean." This is interesting and may be significant taken in connection with my suggestion of a "unit area of populational distribution."

is shown by the fact that the exclusion proposals are never aimed at Asiatics indiscriminately. Without exception, I think, the measures apply only to Asiatics upon whom the economic conditions of their native lands rest most heavily; those, namely, who live by the toil of their hands. The classes—public officials, persons of large affairs, professional men, and students—who enjoy considerable economic independence, are welcome in America, travel widely over the continent, and mingle freely and pleasantly with the citizens everywhere. Because of their approximate economic and cultural equality with those among whom they are, and because of the smallness of their number, these classes of Asiatics give rise to no perplexities, economic, racial or of any other kind.

The race element undoubtedly comes into the labor immigration problem with great force finally, but only as a consequence of economic conditions, and at the locus of greatest pressure of these conditions. Except for the economic element almost certainly there would be no problem of Asiatic immigration for the simple reason that there would be no such immigration.

The sole, or at least the chief motive of Asiatic laborers in coming to America is to improve their hard economic lot. And because of the restraint upon their travel which this hard lot imposes, they are bound to take advantage of the first chance which presents itself for accomplishing their aim.

No Chinaman who has barely money enough to pay the cheapest steamer passage across the Pacific, is going to the additional expense of a railroad journey to Kansas City or St. Louis for work if he can get as good wages in Seattle or San Francisco. And no Japanese farmer who crosses the Pacific under like conditions is going to the Mississippi valley to raise corn and wheat, if he can do better raising potatoes or berries or celery on the bottom lands of the Sacramento and Colorado rivers. Nor is any Chinaman or Japanese going to Lake Michigan or Cape Cod to fish if he can do as well fishing at Monterey or San Pedro. But these basal considerations are not the sole, nor even the most important ones bearing on the case.

Not only is Pacific North America the natural depository for the semi-destitute peoples of eastern Asia who migrate to America, but as long as there exists an immense Asiatic population in such economic condition, and as long as there exist such alluring chances in Pacific America for relieving that condition, it is hardly possible that any device of politics or law or any gentlemanly arrangements will be able to permanently stay the movement for such betterment. The problems concern some of the most elemental and mighty forces of human nature—the forces which antedate and condition politics and law and gentlemanly conduct, as the tree with its roots antedates and conditions the tree with its blossoms and fruit.

During these very last weeks comes the report that 5,000 Asiatics came into the Pacific States of Mexico during March, 1919, and that the total immigration to that country last year was 100,000. And entrance into Pacific Mexico means an entrance into Pacific United States sooner or later. So subtle and pervasive and powerful are the forces which are impelling Asiatic immigration into America that exclusion treaties and laws and other mere contractual arrangements will be incapable of controlling them.

Am I not right in supposing it is the complexity and subtlety of these forces—economic in the sense of physical poverty affecting the great masses of Asiatics; racial as affecting these same portions of both Asiatics and Americans; and instinctive of self-preservation and self-realization of all the people of both continents—that makes the growing breach in the traditional friendships between the United States and Japan incomprehensible to the acutest observers of both countries? "I do not know how to account for it," frankly and almost despairingly declares Baron Shibusawa, one of the oldest and most intelligent of Japan's business students of America. And the replies which he records having received from distinguished Americans to whom he appealed for light, shows that

they are really as much in the dark as he is. One of these Americans, he tells us, assured him, that "the little cloud overhanging the sky will soon pass away."

Terrible, I warn both America and Asia, will prove the illusion if it goes uncorrected, that the ill-will growing between these two old-time friends is only a little cloud that will soon pass away!

But is the gigantic tornado which impends, to be regarded as a fate—as a thing in the hands of a purpose and a power wholly unapproachable, unmodifiable by man? No and ten times no; is my answer. We can convert the devastating tornado into a benign and fructifying wind-and-rain if we so resolve and act according to our resolution.

To point a way, and I am quite sure the only way, toward such resolution and such action is the central aim of my part in this symposium.

My first move in this shall be to remind ourselves that, as a few observers of anti-Asiatic "agitation," often so-called, of the Pacific states have remarked, this agitation is at bottom an expression of the instinct of self-preservation. This remark I wish to supplement by affirming that not only is the instinct of self-preservation on the part of the American agitators involved, but likewise there is involved not merely the same instinct of the Asiatics, but also the instinct of self-realization of both Asiatics and Americans. And I remark that he errs grievously whose observation on instincts has not recognized the difference between the instinct of self-preservation and that of self-realization.

But the point which I wish particularly to fix attention upon in the remarks just made is that the problem as it is actually presenting itself to us, lies chiefly in the domain of human instinct and passion; and that this is only another way of saying that it does not lie chiefly in the domain of human reason.

The quintessence of the proposal I am going to make is that the problem shall be so shifted in its locus that instead of lying primarily in the domain of instinct and only secondarily in that of reason, it shall lie primarily in the domain of reason, of intelligent life and action, and only secondarily in the domain of instinct, of instinctive life and action. And may I not believe that at least in the group of men and women here assembled, scientific as we all are, this proposal shall not be received with listless toleration, as a mere academic pronouncement?

In the interest of grounding my proposal a little more securely on fundamental principle, I remind you of the familiar characterization of all instincts as "blind." And note the unerring truthfulness of our common modes of expression: The "instinct *of*" self-preservation and of self-realization, we say: The instinct of existence is in the very essence of existence itself. Not so with reason. The "reason *for*" we automatically say, self-preservation and self-realization. Existence must justify itself, according to reason. Furthermore, reason must concern itself with the modes and means of existence.

My proposal that the problem of the peoples of the Pacific area shall be carried up so that its larger moiety may lie in the domain of reason instead of in the domain of instinct, means that the Chinese and Japanese and Koreans and Siberians and British Columbians and United Statesans and Mexicans shall take much thought about their self-preservation and self-realization—about why they should be preserved and why they should realize their desires and ambitions; and about the manner in which they should exist and the means by which this may be and ought to be accomplished.

It means, in other words, that the problem should be one of science at its fullest and best; science as the great body of observational and reflective truth concerning external, or material nature, and science as the great body of observational and reflective truth concerning the internal, or spiritual nature of man. And this means economic and cultural justice and morality, international as well as national.

A cardinal aim of all effort in accordance with the principles here indicated, would be to remove the one great inducement to Asiatic

migration to America, namely, the grinding poverty under which the great masses of hand laborers of Asia live at home. Surely it would be disastrous to both western America and eastern Asia as wholes, for the former to become Asiaticized to the extent that the Hawaiian Islands have become so. But the only rational way and, as I believe, the most effective and practical way to prevent this is to make the economic conditions of Asiatic laborers in Asia at least approximately as favorable to them as are the conditions which they find in America.

If statesmanship pronounces this an utterly unrealizable ideal, it thereby merely declares its own incompetency to bring it about, this incompetency being due to the fact that statesmanship of the traditional sort is not primarily a thing of comprehensive, accurate knowledge and reason, but rather only of partial knowledge and of instinct and impulse. And this raises the question, very pertinent at this time: What has been in general the fundamental nature of political motive and action, especially as between nations, down to this time? Has it been mainly rational and intelligent, or has it been mainly instinctive and passionate? Let history answer.

In the cataclysmic condition of the world to-day, three occurrences in particular are recognizable which should encourage the attempt to deal with the Asiatic-American problem on the principles I am setting forth. (1) The revised covenant for the League of Nations (which will surely soon be adopted if reason is indeed now to be enthroned in the government of the world), making the League the central body for coordinating and promoting international activities generally; (2) the provisions of the covenant relating to labor problems which are international in scope; (3) the determination by the American Federation of Labor at the Atlantic City convention (according to press dispatches) to cooperate with Japanese workers for bringing about a better understanding between working men of Japan and the United States.

I venture to predict that were the agencies and movements here indicated to become really active in behalf of the Asiatic-American problem, they would inevitably move in the direction of some such solution of it as I am indicating.

A thing that science can say which ought to contribute much as an initial step in this direction is that the civilized world may assure itself that given adequate scientific investigation and utilization of the resources of nature; and given a due measure of scientific knowledge and of the spirit of justice and morality in politics and law in national and international affairs; and given, further, a due sway of reason in the growth of population, and no people of the world need live in danger of starvation or even of serious want. The proposition is surely susceptible of something approaching demonstration that the dogma of the inevitability of material poverty for great sections of the world's population is a mark of primitiveness, of immaturity of human societies.

And I wish here to affirm the unhumanness of national policies which encourage large families in the interest of large armies and cheap labor.

Probably the foremost significance of reason in the human animal is that it is the device or agency developed by nature to relieve the species from the uncertainty and precariousness of material sustenance as instinct alone is able to secure it.

To develop the latent natural resources of the whole Pacific area, of land and water alike, and then to distribute and use the fruits obtained in such fashion that all portions of all the populations shall be beneficiaries in just ratio, would be exactly one of the most characteristic things which these peoples could do as rational, *i. e.*, as truly human animals.

This paper and those to follow in this symposium are so many indices of what would be involved in carrying out such a proposal so far as the great ocean itself is concerned.

Many decades of common experience with, and scientific research upon the oceans of the earth, the atmosphere which overspreads them,

and the life which teems in their waters, have yielded large knowledge. Much of this knowledge is revelatory of great riches in living beings useful to man. And revelatory, too, is the knowledge of how intimately the life and health and happiness of men are dependent upon the oceans themselves because of certain of their physical and chemical attributes; and upon the atmosphere which is a sort of vital nexus between sea and land.

But the knowledge thus far obtained as to these beneficences is hardly more than an outline the details of which are yet to be filled in.

The papers which are to follow will present portions of the sketch more clearly, and will indicate in some particularity what filling in of details would probably show, and the means by which the task would have to be done.

Far more knowledge is essential as to what useful organic resources the waters contain; as to how these may be utilized; and as to how they may be made permanent as well as useful.

Greater knowledge of the ocean itself and the atmosphere must be had in order that the harvesting and the conserving of its resources may be more certain and safer; in order that all travel upon the sea may be facilitated; and in order that those aspects of the land's productiveness which are largely influenced by the conditions of the sea may be brought more under the control of man.

Knowledge, and ever more knowledge, is the watchword in this aspect of the great problem: and of such nature and so broad is the requirement that it is well nigh indispensable that all the peoples whose interests are involved should participate in securing it. Common needs of world-population demand common world scientific research and world effort in affairs.

And now, taking this very meager statement as a foundation to go on, I venture to summarize, in the name of world science and the spirit of it, what the problem of peoples of the Pacific area is, and by what methods it could be resolved. It is a problem in which the two elements of economics and race are so enormously potent that little wonder need attach to the fact that many students anxiously observing the animosity growing up between Japan and the United States particularly, conceive that the problem is wholly either the one or the other, or at most both of these elements. But not so. It is a problem of the whole gamut of human nature as this manifests itself in two great groups of highly and equally, though diversely civilized peoples of different though equal races, coming into economic conflict with each other.

And just because the two groups stand high and essentially equal in civilization; and just because each is within itself, predominantly guided by rational knowledge and conduct, the only possible real solution of the conflict between them must be likewise through rational knowledge and conduct. It is then heavily incumbent upon those men and women in both groups who are professed and acknowledged leaders in the life of the intellect, not only to bring home to our fellows what is involved in this way of solving the problem, but also to bring home to them what would almost certainly result from leaving the problem where it now is, namely predominantly in the realm of instinct and passion. This last means that our duty is to proclaim the indubitable fact that the counterpart of the instinct of self-preservation throughout the whole animal creation is the fighting instinct; and that consequently fighting—war—will be an almost certain consequence of leaving the problem where it is, this implying an almost certain irrational, unjust, and destructive treatment of the problem.

And upon those of our fellows, the numbers of whom are, unfortunately, neither few nor powerless, who oppose the rule of reason in such matters, and favor the rule of instinct, let us not fail to impress the lesson of Germany at this hour, as an example of the doom that awaits any modern nation whose international conduct is based more on instinct and brute force than on reason and moral force.

"All that take the sword shall perish with the sword." The profound natural truth which comes to expression in this familiar

phrase, has never been more terrible exemplified than by Germany, yesterday wielding her vast might of intellect and muscle to dominate the world; to-day cast down to the very dust and utterly impotent.

Nature herself, working through the process we have named evolution, has produced an agency, the human reason and intelligence, one of the main purposes of which is to find a better way, *i. e.*, a more efficacious, more certain, and less destructive way than war for solving problems of human preservation and realization.

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SOME NECESSARY STEPS IN ANY ATTEMPT TO PROVE INSECT TRANSMISSION OR CAUSATION OF DISEASE

The study of the causation of disease is attracting far more attention to-day than it ever has in the past, but it is to be regretted that there is not a larger proportion of this effort being directed toward locating the possible intermediate hosts and invertebrate carriers.

Many excellent investigations have been carried out with all other phases complete, but the question of invertebrate carriers is often left in a very indeterminate stage. The majority of the investigations which have been seriously undertaken to determine invertebrate carriers have been conducted on other continents than ours. There is a great field for investigation along these lines open to investigators in America. In order to stimulate such research, I have attempted in this paper to set down some of the necessary steps for successful investigation.

I. Cooperation

I consider essential to a thorough investigation of disease transmission, the establishment of a perfect working agreement and hearty cooperation between one or more physicians and diagnosticians, one or more parasitologists, and one or more entomologists. It is not safe nor does the effort bring the proper amount of credence, when one man attempts to do the whole work. Each phase of such an investigation should be handled by an expert on that phase. The day of the solitary investigator is past and we are now in an era of group-investigations which carry with them weight and conviction. Of course certain preliminary steps may easily be taken by any one member of a proposed group or it may be possible that they may arrive at an advanced stage by independent work, but the time will come in each investigation when a cooperation of investigators will attain the most satisfactory results.

II. Where should the Investigations of Insect Transmission Begin?

There are two distinct lines of approach to this problem of insect transmission. The first is to work from the known disease and to ascertain by experimentation what species of insects might be concerned in its transmission. The other line of approach is to make a study of all the insects whch might be involved in disease transmission and to obtain, by cultures and microscopic studies, a knowledge of the parasitic organisms normally and occasionally found in these insects. Working on this line of investigation, one might in time of an epidemic start with insects visiting excreta and attempt to ascertain whether the organism of the disease at that time epidemic occurs in any of these insects.

The first line of investigations would rise from public necessity and probably be initiated by physicans and parasitologists, or by the suggestion of entomologists.

The second line of investigations would probably originate as problems assigned by a professor or head of a laboratory to students or investigators under his direction. It is highly desirable that such studies be commenced in as many institutions as practicable in the near future. Such investigations will include bacteriological studies, protozoological studies and helminthological studies, as well as investigations of the life histories of the insects, and the possible connection between them and disease transmission.

III. PLAN OF OPERATION

Before starting out on any lines of experiment in this subject, there should be written down in concise form the facts already gleaned on the practical problems of the theories which have occurred to the various members of the group. A clearly outlined course of action should be made and be carefully discussed and then the various steps in the investigations thus outlined should be read and modified to meet the changing views resulting from the experiments. The course of the work should always be kept plainly in view. Each step should be rigorously and skeptically scrutinized for defects.

In as much as the investigation from this point will consist of the answering by observation and experiment of a series of pointed questions, I shall proceed with my discussion in the form of queries. Probably many other vital queries will occur to the reader, but it is more than possible that he may overlook some of these if not set forth here. When each query is satisfactorily answered the problem is practically solved.

IV. HOW CAN AN INSECT BE INVOLVED IN DISEASE TRANSMISSION

Insects[1] may be involved in disease transmission either by the transmission of an organism or the inoculation of a toxin or they may be an intermediate phase in the life cycle of an organism, but not come directly in contact with the final host.

1. *What kind of organisms can insects carry?*—It has been demonstrated that insects can carry bacteria, many types of protozoa and many species of parasitic worms, and also that certain species of insects may be instrumental in carrying eggs of other species of insects which cause disease.

2. *In what manner may insect toxins bring about disease?*—Many species of insects bite, and inoculate, at the time of the bite, a toxin which may at times cause serious trouble.

Some invertebrates inoculate the toxin by means of the mouth, some by means of a claw, some by means of a caudal appendage, others by means of the ovipositor. In some cases the invertebrate penetrates the skin with its mouth parts and as long as it is adhering, toxins are created which may in certain cases cause severe paralysis or death. The accidental eating of certain insects in food will cause poisoning because of the toxins contained in the bodies of these insects. It is believed, but not yet satisfactorily demonstrated that the pollution of food by the excreta of certain insects may cause certain nutritional diseases.

The presence of certain insects in the tissues causes severe irritations and often the formation of toxins.

3. *Can insects themselves cause disease?*—Many species of insects are known to live parasitically upon the bodies of man and animals and by their constant sucking of blood or gnawing, cause skin diseases. Other species of insects habitually lay their eggs on or in the flesh and breed commonly or exclusively in living flesh, causing a destruction of the tissues. Many species of insects are dependent upon mammalian blood for the necessary nutriment to bring about reproduction. Some insect larvæ are blood suckers. It is not at all uncommon for insect larvæ to be ingested in food and for them to continue their development in the intestines or other organs, often at the expense of the tissues. In some parts of the world insects are eaten as food by the natives, sometimes in a raw state, and it is not uncommon in such case for the natives to be infected with parasitic worms which pass their intermediate stages in the bodies of these insects.

4. *Where may insects obtain the organisms which cause disease?*—Disease organisms may be taken up by insects directly from the blood of an infected host or they may be obtained by sipping infected surfaces of the body or taken up from the feces or other excretions of an infected host. The insect may take up the organisms from these excretions either in its larval or its adult stage.

5. *How can the insect transmit the organ-*

[1] By insects, in this article, are meant those forms of invertebrates popularly called insects, including the Arthropoda.

ism?—The organism may be transmitted by the insect by direct inoculation through the proboscis, involving the active movement of the parasite, or the passive transmission of the parasite in the reflex actions which take place in the sucking of blood. The organism may be externally carried on the beak of the insect and mechanically transmitted at the time of sucking. It may be located in the mouth parts of the insect and burrow through at the same time the insect is feeding. It may be in a passive state on the insect and become stimulated to attack the host when it comes in contact with the warm body. The organism may be regurgitated by the insect on the body of its host and obtain entrance by its own activity, or by being scratched in, or by being licked up by the host.

On the other hand, the organism may pass through the insect, and pass out in its feces, or in malpighian excretions. It may be washed into the wound made by the sucking of the insect, by fluids excreted at the time of the feeding. It may remain in the feces on the host and ultimately be scratched in or licked up by the host.

The organism may be taken up by the insect and never normally pass out of the insect, but be inoculated by the crushing of its invertebrate host upon the body, and the scratching of infected portions of the insect's body into the blood.

Quite a series of disease organisms find their way into the hosts because of the habit of the host of feeding upon insects.

6. *What is the course of the organism in the insect?*—If the organism is taken up by the insect in its larval stage, the organism may pass directly through the larva and out in its feces and may quite conceivably pass in this manner through insect after insect larva before it finally finds a vertebrate host. The organism may be taken up by the larva and remain dormant in some portion of the larva's anatomy, or, on the other hand, it might undergo considerable development and multiplication in the larva and remain there through all the metamorphosis of the insect until the latter arrives at maturity, at which time development of the organism may begin or may continue.

Upon being taken up in the blood by the bite of the insect, the organism may lodge in the œsophagus and carry out all its metamorphosis there, or in some of the organs of the head and find its way into the salivary glands and through the salivary secretions into a new host.

It may, on the other hand, pass back into the gut, or into the stomach; from the stomach its path may lead in many directions. It may pass on in its course of development into the rectum and out in the feces, or it may enter the fatty bodies or pass into the general cavity of the insect, or it may migrate forward into the œsophagus and into the labrum; and it may pass into the malpighian tubules, or into the ovaries.

The organism may enter the eggs and remain therein through their development into the larvæ or nymphs and be transmitted at some stage of the development of the second generation.

7. *What is the course of the organism on leaving the insect?* The organism may leave the insect in the saliva and immediately enter the blood puncture. It may bore through the labrum of the insect at the time of feeding and enter the puncture. It may leave the rectum of the insect on the malpighian glands and be washed into the puncture by means of the secretions of the coxal glands, or some other excretions made at the time of feeding. It may be excreted in malpighian secretions, or rectal feces, or regurgitated in vomit, and may lie dormant on the skin of the host, or in the food of the host, until it is scratched into the blood, or is taken into the mouth.

On the other hand, it may be possible that the organism requires another host after the insect, and before it reaches its final host. There are cases on record of the insect being the first host, and two or three other animals in succession being hosts of later stages.

V. WHAT IS KNOWN ABOUT THE DISEASE TO BE INVESTIGATED?

It is a primary essential that all the workers be able to recognize the disease which they

are trying to study and that they be fully informed about it, so that they may be able to grasp possible solutions of their problem. They will, therefore, seek first to answer the following questions:

1. What is the history of the disease and how long has it been known? How serious has it been?

2. What is its distribution?

3. Does it occur in pandemic, epidemic, endemic or sporadic form?

4. In what seasons of the year is it most prevalent.

5. Is there any apparent relationship between its distribution and the physical, biological or climatic features of the countries where it occurs?

6. Does it affect any particular group, occupation, sex, race or nation of people, or any particular species of animal?

7. May any wild animal be considered as a reservoir?

8. Has immunity or difference of susceptibility been recognized and under what circumstances?

9. What are the symptoms of the disease?

10. What have autopsies shown?

11. What treatment has been designated?

12. What is known or suspected about its causation and dissemination?

13. What possible theories can be advanced to account for its causation and dissemination?

A little time spent in collecting those facts may save much effort later.

VI. WHAT INSECTS SHOULD BE INVESTIGATED?

A thorough entomological study of this question may prove a valuable short cut to the investigation. Many insects will be eliminated by the entomologist before he has finished his preliminary work. He will attempt to answer the following and many other questions and will probably have to answer them to the satisfaction of all his fellow workers.

1. What insects coincide in distribution with the general distribution of the disease?

2. What insects occur in peculiar habitats of the disease?

3. What blood insects occur in the locality under investigation?

4. What is the relative abundance of these insects?

5. Is there a coincidence between the season of abundance of any of these and of the disease?

6. What insects occur in the homes, nests or haunts of infected hosts?

7. What insects are found on infected hosts?

8. What insects occur in the working quarters of the patients?

9. What insects would be most apt to affect the particular group of hosts most susceptible?

10. What insects breed in or frequent the excreta of the hosts?

11. What insects are found at the food of the hosts?

12. What insects are found at the sources of the food of the hosts, such as the milk?

VII. WHAT IS NECESSARY IN THE TRANSMISSION EXPERIMENTS?

The investigations which have preceded will have narrowed the question down to certain species or groups of insects which need to be critically studied. All of those insects which come in contact with the blood of the patient, or the food of the patient, or the feces of the patient, must be given special attention. At this point the bacteriologist, protozoologist or the helminthologist finds his special work beginning. There will be many points which must be worked out by cooperation of the parasitologist and entomologist.

Considering first the blood-sucking insects, it is necessary to determine:

1. Can the particular insect take up the organism with the blood?

2. Does the organism pass into the intestinal canal or does it stop at some point en route?

3. To what extent is the organism digested by the insect?

4. In what organs of the insect can the parasite be demonstrated from day to day?

5. Are any changes in the organism demonstrable?

6. What path does the organism seem to follow in the insect's body from day to day?

7. Does this movement of the organism suggest whether the transmission is by inoculation or does it suggest that the organism will pass out of the body in some of the excreta?

8. Can the organism be demonstrated in the mouth parts of the insect at the time of feeding?

9. Can the organism be found in any of the excretions of the insect?

10. How long is it before the organism reaches the mouth or the rectum?

11. What is the earliest date at which it can be found in the feces?

12. What is the earliest date at which infectivity of the host can be obtained by the sucking of the blood?

12. What is the earliest date at which infectivity can be obtained by scratching in of feces or portions of the insects?

14. Can infection be obtained by either natural or artificial inoculation without demonstration of the organism?

15. Is the infective organism or virus filterable?

16. Can the virus or organism be transmitted hereditarily?

17. At what stage of development in the second generation does hereditary transmission become possible?

18. Can the organism be taken up by the immature stages, feeding in infected excreta?

19. Can the organism be taken up by immature stages of an invertebrate feeding on the host?

20. How long can the immature forms of the invertebrate, infected by whatsoever manner, retain the organism in their system?

21. Does it stay during metamorphosis?

22. Does it undergo any changes preceding or following metamorphosis?

23. At what stage in the metamorphosis does the insect begin to be infective after taking up such organisms?

24. How long can the insect remain infected?

VIII. HOW SHOULD EXPERIMENTAL INSECTS BE HANDLED?

A large proportion of the failures in studies of insect transmission in the past have arisen from improper handling of the insects. The breeding and handling of the insects is an art in itself, just as is the culturing of bacteria or protozoa. In fact there are more diverse requirements for handling insects of different species than can be found elsewhere in the animal kingdom.

1. *What must be known about the insect before beginning transmission experiments?*—The normal conditions of life of the insect must be ascertained: its reactions to heat and cold, moisture and dryness, disturbance, color, light, odor; its food, and the proper condition thereof; its methods of reproduction, and what food is necessary for reproduction; if soil should be provided, and what conditions it should be in; if water should be provided, and whether this water should be alkaline or acid, clear or containing foreign matter, and in such case what type of foreign matter; whether the water should be still or in motion, warm, moderate or cold.

2. *What type of breeding cage should be used?*—A breeding cage must be used which will most nearly enable the experimenter to keep the insects under control and yet reproduce essential conditions for maintaining reproduction. Much of this information is normal healthy life of the insects and normal available in entomological literature. Many insects probably involved in disease transmission have not been properly studied and breeding technique is yet to be worked out.

3. *Water is necessary in some form in practically all insect breeding.*—There are more failures to properly breed insects traceable to improper humidity, or to the lack of moisture in the proper form for the insects to drink. Much detailed observation may be necessary to obtain this important information in the case of many insects.

4. *There is a combination of temperature and humidity most favorable for life, for each species,* and *differing from one species to another.*

4. *The food of an insect must be in a particular condition in order to obtain normal breeding.* It may require a certain degree of

immaturity, ripeness or fermentation. It may require a certain degree of desiccation.

Many other details must be attended to by each specialist involved in the investigation, and we probably have yet to see a single disease problem which has been completely rounded out and solved for future generations.

IX. HOW SHALL WE RECORD OUR OBSERVATIONS?

Undoubtedly the most satisfactory method of making a large series of records is to use some type of loose-leaf card or sheet filing system. By such means one can always keep in an orderly arrangement all the facts so far obtained. In the case of investigations of the causation of a given disease, one of the most satisfactory methods which has been used for recording observations is to prepare a little blank booklet, which will fit the filing system, in large quantities, each book to represent a case. This book should contain pages for each phase of the question, with blanks covering all kinds of minutes about this phase. The whole series of observations can be tabulated for each point.

W. Dwight Pierce

Washington, D. C.

THE U. S. FOOD ADMINISTRATION'S WAR FLOUR

The U. S. Food Administrator, Mr. Herbert Clark Hoover, met and solved one of the greatest problems of the war. Prompt and seemingly drastic action was necessary in order to conserve wheat and vanquish the specter famine. The way in which this was achieved is so well known that recounting is unnecessary.

Bread is a nation's chief food, and in order to maintain an adequate supply during the war there were but two courses open for the Food Administrator to follow: To require the use either of substitutes, or of whole wheat flour, also known as long extraction flour. As head of the commission for relief in Belgium, Mr. Hoover was familiar with the results arising from the exclusive use of whole wheat flour in rationing a nation, and they were such as not to warrant a repetition of the experiment in the United States. It is most fortunate that no impractical dreamer, bent upon repeating an experiment that had failed was in charge of the U. S. Food Administration. Mr. Hoover's plans for the conservation of food and wheat in particular, rested upon basic scientific principles.

At the time Mr. Hoover assumed control there was a shortage of wheat and a fair supply of other cereals, particularly corn and barley. It was a question as to the best use of these cereals for human and animal foods. Corn and barley alone were not suitable for bread making, as they lack the gluten or binding material of wheat. Gluten is contained only in the floury part of the wheat and there is none in the wheat bran except that present in any flour that may have failed to be separated from the bran. As wheat bran and other wheat by-products contain no gluten binder they are on a par with corn and barley so far as physical bread-making value is concerned. The Food Administration took a broad view of the question and recognized that in addition to bread there must be maintained an adequate supply of milk and animal fats as pork.

Naturally the question hinged upon the relative merits of bran and corn and barley flours as human and animal foods. All available data plainly indicated that a pound of corn or barley flour furnishes the human body with more digestible protein and available energy than a pound of wheat by-product. In the animal ration, however, the wheat by-product has a higher productive value than the corn or barley.

Some recent experiments of the U. S. Department of Agriculture, conducted during the war by Arthur D. Holmes, specialist in charge of Digestion Experiments, Office of Home Economics, have an important bearing upon this subject. He reports that in eight digestion trials with men fed on fine bran bread in a simple mixed diet, an average of 44.7 per cent. of the bran protein was digested and 56.6 per cent. of the bran energy was available. In the case of unground bran 28 per cent. of the protein was digested and 55.5

per cent. of the energy was available. It is to be noted in five of these sixteen digestion trials negative results as to the digestibility of the protein were secured; that is the body actually sustained a loss of protein because of the bran consumed. "The reports made by the subjects regarding their physical condition vary from 'normal except for occasional slight pains in the stomach after eating to extreme laxative effect.'"[1]

Mr. Holmes reviews the earlier digestion trials of the U. S. Department of Agriculture, made by Woods and Merrill of Maine and Snyder of Minnesota, and reports:

	Digested Per Cent. Protein	Digested Carbohydrates
White flour	88.1	95.7
Whole wheat flour	81.9	94.0
Graham flour	76.9	90.6

Mr. Holmes's work shows that wheat bran has low digestibility as a human food. He says: "It is hoped the results of the experiments here reported when considered in connection with the available data on the digestibility of wheat will be of value in determining the most economical and physiological method of utilizing wheat for human food."

When used as animal food bran and wheat by-products have a much higher digestibility than when used as human food. Jordan reports that on an average 77.8 per cent. of the protein of bran and 79.8 per cent. of the protein of middlings are digested by animals. Thus it is quite evident that a pound of corn flour or barley flour furnishes more nutrients in a human ration than a pound of wheat by-product and on the other hand a pound of wheat by-product furnishes more nutrients in the animal ration than a pound of corn or corn flour and this is because the bran has a low digestibility as human food. In view of the facts it is quite plain the U. S. Food Administrator made no mistake in the adoption of the "substitute" flour as a conservation measure instead of the use of whole-wheat flour.

The Victory Bread of the United States made from 75 per cent. white flour (war standard) and 25 per cent. "substitutes" was far superior to the long extraction or War Bread of Europe containing no substitutes. A quotation from Alonzo E. Taylor's "War Bread" relative to the quality of the whole wheat or long extraction flours used in Europe is interesting:

> It is the experience of the nations at war in Europe that they would abandon higher extraction and return to mixed flours prepared from standard flour, provided this were possible. Breads made in England of standard (American flour diluted with an admixing flour) are much better than straight breads of 85 per cent. extraction flour. The Victory bread of the United States is so superior to the war bread of the Allies and of the enemies as to be past comparison. (Page 86.)

The "Substitute Plan" adopted by the United States Food Administration resulted in the conservation of more wheat, and the production of better bread and more nutritious than would have been possible if the whole-wheat plan, so vigorously advocated by some, had been adopted.

Dr. Armsby, director of the Institute of Animal Nutrition of the Pennsylvania State College, in his booklet "The Conservation of Food Energy," which was published about a year ago, gives some interesting data upon the utilization of cereals. He records the available energy per 100 pounds of flour as follows:

	Therms
Straight or standard patent	165.0
Whole wheat	156.1
Graham	150.5

After discussing the efficiency of animals to utilize cereals, and the food value of animal products, considering the overhead feed cost in producing such products, he concludes that:

> It is clear, then, that the endeavor should be to utilize as large a proportion of vegetable products as is possible directly as human food, leaving only the by-products to be fed to stock. In the case of cereals this is accomplished chiefly by some form of milling. (Page 58.)

It is to be noted that the figures which Dr. Armsby uses for flour milling (73 per cent.

[1] Page 17, U. S. Dept. Agr. Bulletin No. 751.

extraction) are for the pre-war flour. The U. S. Food Administration during the time of the shortage of wheat required approximately a 75 per cent. extraction. It is necessary to keep in mind this difference in the pre-war and the war standard milling basis in making comparisons. The tables show that when 100 pounds of wheat are milled into 73 pounds of flour (pre-war basis) and 27 pounds of feed, the flour being used as human food and the feed part for pork production, the pork in turn being used as human food, a total of 78 per cent. of the original therms of the wheat are utilized as human food. When, however, the calculations are made on the war standard milling (75 per cent. extraction) and the bran is converted into milk, and finally the cow into beef, while the middlings part of the wheat by-product is fed to pigs, which is the common practise in the use of wheat by-products, a return of over 80 per cent. of the therms of the original wheat is secured, which is somewhat more than is obtained when the wheat is milled and utilized as whole-wheat flour.

Even without the use of substitutes the Food Administration flour of 75 per cent. extraction, with a limit as to the amount of flour used per capita, would have been a better conservation measure than whole-wheat flour, because the therms from the milk, pork and small amount of beef are more valuable than the therms derived by man from the direct consumption of bran in whole-wheat flour bread. The quality of the therms as well as the quantity must be considered.

But the greatest conservation of wheat reresulted when "substitutes" were used and a review of all the facts shows that the U. S. Food Administration could not have made the wheat supply "go farther" by milling it as whole-wheat flour. It would have gone no farther and the consumer would have had poor bread. The old adage aptly applies to this case—"Go farther and fare worse." The U. S. Food Administration's flour milling and bread-making plans accomplished results in the most efficient and satisfactory way possible.

HARRY SNYDER

EDWARD COWLES

DR. EDWARD COWLES, who died at Plymouth, Mass., on July 25, at the age of eighty-two, was in many respects a remarkable man and had a remarkable career. He graduated from Dartmouth in 1859, where he received his M.D. two years later. He entered the Union Army, retaining his connection with it until 1872, when he became resident physician and superintendent of the Boston City Hospital, and in 1879 of the McLean Hospital for the Insane at Somerville. He directed its removal to Waverley and supervised the erection of perhaps what was then the finest hospital of its character in the world. This superintendency he resigned in 1892 because of ill health. The institution is to-day very largely a monument to his efficiency and foresight.

He was also a pioneer in the professional training of nurses for the care of the insane, but most important of all was the fact that he was the first in this country to conceive and carry out the system of scientific study of the insane within the institution itself with proper laboratory equipment and a corps of experts. It was due to his initiative that men like Dr. Adolf Meyer and Dr. Hoch were brought to this country and that other men now prominent were started on their careers. It is generally understood that his enthusiasm for the development of this scientific side of hospital work was one cause of his retirement.

He was professor of mental diseases at Dartmouth and instructor at Harvard Medical School until 1914, and for sixteen years was non-resident lecturer at Clark University, where he was one of the original trustees.

He was a member of the Alpha Delta Phi, Phi Beta Kappa, and Loyal Legion, and belonged to the St. Botolph Club of Boston, besides being a member of many scientific societies.

In his later years Dr. Cowles followed with intense interest the rise and decline of Kraepelin's views, with which his sympathy was limited. He was also interested in psychoanalysis, though not convinced of the extreme views of Freud. The list of his sci-

entific publications, though not large, constitutes an important contribution to American psychiatry, and two or three of them are hardly less than classic.

Personally he was one of the most attractive and charming of men because of his sympathy, unfailing flow of good humor, and his broad judicial mind.

G. STANLEY HALL

July 28, 1919

SCIENTIFIC EVENTS

GAME CONSERVATION IN CANADA

A STATEMENT made by the Dominion Parks Branch, Department of the Interior, relating to the North-West Game Act, shows the efficacy of the act, in placing the fur trapping and trading industry under control, in the interest of game conservation. Organization in connection with the new Northwest Game Act passed in 1917 has taken place under the present government. The most notable and important feature in this connection is the fact that for the first time in the history of the Northland the fur trapping and trading industry has been placed under adequate control. Under the new act all white trappers and traders are under license.

In connection with the northern hinterland the government has also taken a very important step by the organization of a commission for the purpose of first, ascertaining the feasibility of the development of reindeer herds for the purpose of providing a meat supply for the Dominion, and, second, ascertaining the feasibility of the domestication of musk-ox in the north not only for the purpose of a meat supply but also for the purpose of a wool supply.

With respect to both these matters the situation is as follows: It is estimated that there is an area of about one million square miles in the north eminently suitable for the development of reindeer and musk-ox herds. Throughout the world there is a constant invasion of the areas used for cattle grazing through the lands being taken up for the production of fruits and cereals and the meat situation of the world is therefore gradually becoming more and more acute. Northern Canada is not suitable for the production of ordinary farm products but from the fact that millions of Barren land caribou, which physiologically are practically identical with domestic caribou, are known to thrive there at present; and from the fact that musk-oxen also thrive in the north there appears to be good reason for the expectation that with the development of reindeer and musk-ox herds the north may take the place of the more southerly portions of Canada in the matter of meat production.

While the migratory birds treaty was prior to the Union Government, organization has taken place since. This treaty with the United States provides for the protection both in the United States and Canada of practically all the beneficial migratory birds. Arrangements have been made with most of the provinces by which they have amended their game laws to harmonize with the terms of the treaty and by which the provincial game authorities enforce these laws. While the provincial laws have not all been satisfactorily amended, *e. g.* (maritime provinces) a staff of wardens has been appointed in these provinces and active steps have been carried on not only for the enforcement of law but for the education of the public as to the necessity of adequate protection of beneficial bird life.

In furtherance of the policy of bird conservation some twenty-eight suggested locations in the west for breeding sanctuaries have been inspected. In addition the Dominion has created Point Pelee, the most important bird area in Ontario, into a Dominion Park in order that it may be maintained as a sanctuary. The Dominion has also established as bird sanctuaries Bird Rocks, Bonaventure and Pierce Rock (all in Quebec), under the terms of the treaty and at the request of the Dominion the province of Quebec has passed provincial legislation on similar lines.

In addition the department has been issuing special bulletins and otherwise carrying on an educational campaign throughout Canada with the object of enlisting the sympathetic support of the public for bird protection.

Through the Advisory Board on Wild Life

Protection which operates under the authority of the Department of the Interior, the first thoroughly national conference on wild life protection which operates under the authority of the Department of the Interior, the first thoroughly national conference on wild life protection was held in Ottawa in February, 1919. Representatives of all the provinces and leaders in wild life protection took part in the conference. The purpose was to bring together every one in the Dominion specially concerned in the protection of the important wild life natural resources of the country and by the exchange of ideas to develop cooperation and efficiency throughout the country in the conservation of wild life.

A COLLECTING BOAT FOR THE NEW YORK AQUARIUM

THE New York Aquarium will soon improve the method of collecting its living marine exhibits, the New York Zoological Society having provided funds for the construction of a large well-boat for that institution.

Hitherto the marine collections of the Aquarium have been transported in shipping tanks of limited size, such as could be readily handled on launches or wagons. This method is a primitive one and subjects the occupants of the tanks to more or less crowding and rough usage, with considerable losses in transit.

With a collecting boat available, specimens can be transferred directly from the nets used in capture to the spacious *well* of the boat, where they will remain undisturbed until their arrival at the sea wall behind the Aquarium.

The boat is nearly completed and will be launched early in August. It has a length of thirty-five feet and a depth of water in the well of two and a half feet. It is driven by a twenty-five-horse-power engine, and is also sloop rigged. There are cabin accommodations for four men and stowage space for nets and dredges.

This boat is of staunch construction and will be capable of going anywhere along the adjacent coast. The well being ten feet square, will not only accommodate fishes of larger size than it has hitherto been practicable to transport, but will carry large numbers of specimens without loss. It is important that living marine animals intended for exhibition should reach their destination not merely alive, but in condition to survive in captivity.

While the hundred or more exhibition tanks of the Aquarium usually contain five or six thousand specimens, of two hundred or more species, they have never exhibited half the wealth of species available in the New York region. This has been due solely to lack of facilities for getting the best results. The boat will be manned by the employees of the aquarium and should be able to do all the collecting that will be necessary on week-end trips. It is estimated that the cost of operating the boat will offset the cost of hiring wagons and launches, while the results secured will be immeasurably better.

The aquarium has for many years freely furnished small marine forms of life to the schools and colleges of New York City. An increased supply of such material should enable the aquarium to be still more generous in the distribution of its surplus for educational and research work, while the two millions of persons visiting the institution yearly, will see many northern marine forms that have not yet been exhibited alive.

C. H. TOWNSEND

THE NATIONAL RESEARCH COUNCIL AND THE ROCKEFELLER FOUNDATION

AT a meeting of the Executive Board of the National Research Council, held in June, on behalf of the Division of Physical Sciences, Mr. Millikan, as retiring chairman, recommended that a communication be sent to the Rockefeller Foundation requesting an annual appropriation of $20,000 for two or three years' traveling expenses in connection with the plan of stimulating and organizing research in physical subjects through the formation of groups of research men in these subjects. The executive board voted to approve the forgoing recommendations of the Division of Physical Sciences and that the chairman of the council be authorized to address a letter to the Rockefeller Foundation requesting an annual appropriation of $20,000 for two or three years in support of these plans.

The executive committee of the Division of Chemistry and Chemical Technology voted that the use of such a sum for a similar purpose in connection with chemical research would not be a wise expenditure at the present time for the following reasons:

1. The proposed plan, to be successful, would require the enlistment of the services of the best men in the country in traveling about and consulting with the various research workers. Such a utilization of their time would detract just so much from the progress of their own research work, with no certainty that the hoped-for stimulation and organization of the research workers of the country would exceed in value this loss.

2. The committee also feels that the first step in attaining the purposes of the proposed project should be a carefully prepared and indexed research census and that the promotion of cooperation between investigators working along similar lines can be best attained by calling a conference at some central point. The program of work for each such conference should be carefully worked out in advance by correspondence with the investigators, supplemented by such personal visits as the chairman of the Division may be able to make.

3. In view of the amount of preparatory work to be done in connection with securing the necessary data, corresponding with the research workers, and arranging the program for such conferences, the committee does not feel that during the first year it would be practicable to call more than five such conferences, but feels that a sum of money, not to exceed $7,000, could be wisely and fruitfully expended in this way during the first year and would be glad to join the Physics Division in requesting such a sum from the Rockefeller Foundation, to be used in this manner. It feels, however, that any requests for additional amounts should be based upon the knowledge and experience gained during the first year.

THE PATRON'S MEDAL OF THE ROYAL GEOGRAPHICAL SOCIETY

At the anniversary of the Royal Geographical Society on June 2, the medals were presented in accordance with the announcement already made in Science. The president of the society, Sir Thomas Holditch, in presenting the patron's medal to Mr. Butler Wright for Professor W. M. Davis said:

The Patron's Medal is awarded to Professor William Morris Davis, of Harvard University, for his eminence in the development of physical geography. He is the most eminent of living American geographers, and has devoted his life to investigations in physical geography and to the teaching of geography as a university subject at Harvard, and as visiting professor in several European universities. At the commencement of his career he devoted much attention to meteorology, and his "Elementary Meteorology, 1894" is a standard work. Later he had practical experience as a geologist on the U. S. Geological Survey. For forty years he has given his main attention to the physical geography of the land surface, on which he has published several books and very many papers, some of the most important of these in the *Geographical Journal*. Professor Davis has travelled throughout North and South America and Europe, widely in Asia (including an expedition to Turkestan), Africa and Australasia. All the leading geographers of Europe have at one time or another taken part in geographical excursions on a great scale led by Professor Davis, and have borne witness to his extraordinary grasp of physical features and his power of exposition in the field. As a university teacher he introduced new methods of study, especially in his geographical laboratory at Harvard, which have proved of high value in scientific training. As a theoretical geographer he is known mainly by the completeness with which he worked out the geographical cycle of erosion, and the consequences which follow from the application of the conception. All the work of Professor Davis, both in the field and in the study, is marked by a forceful originality which has acted as a vivifying stimulus to several generations alike of disciples and critics. It is not too much to say that his writings have been largely instrumental in displacing German in favor of English as the language of advanced work in geography. Mr. Butler Wright has undertaken to accept the medal on behalf of Professor Davis, and it is with honor that I give it to so distinguished an American. There has always been a good feeling between American geographers and ourselves, and I hope that this will be a small token that it will continue.

SCIENTIFIC NOTES AND NEWS

The fiftieth anniversary of the appointment of Dean George H. Perkins as professor of geology in the University of Vermont was celebrated at the recent commencement. The

exercises included addresses by prominent alumni and the presentation of a fine portrait by Carle J. Blenner, of New York, which is to hang in the library. For the past two years Dean Perkins has been acting president.

Lieutenant Colonel Wilder D. Bancroft, professor of physical chemistry at Cornell University, now on leave as acting chief of the Chemical Warfare Service, U. S. A., was the recipient of the honorary degree of doctor of science at the June commencement of Lafayette College.

On June 2, the Secretary of War conferred upon Lieutenant Colonel Edward Orton, Jr., Motor Transport Corps, formerly in charge of the Service Division, the distinguished service medal, with the following citation: "His untiring energy and splendid judgment were displayed in the efficient organization of the Engineering Division of the Motor Transport Corps, in bringing about standardization of equipment and supplies and in efficiently directing the forces of the motor industry to the mutual advantage of the Army and Industry itself." Lieutenant Colonel Orton was formerly dean of the college of engineering, Ohio State University.

The Ricketts prize of $250, given by the University of Chicago each year to its students for the best research work in bacteriology, was divided between E. B. Fink and F. W. Mulson, both doctors of philosophy.

Dr. Nelson W. Janney, formerly chief of the medical services of Base Hospital No. 99, American Expeditionary Forces, has resigned his professorship in the New York Postgraduate Hospital to succeed the late Dr. Nathaniel Bowditch Potter in the directorship of the Memorial Laboratory and Clinic for the Study and Treatment of Nephritis, Gout and Diabetes, Santa Barbara, Calif.

Howard Fonda has returned to his position in the department of bacteriology in the Long Island College Hospital, Brooklyn, after eighteen months' service in France.

Captain Oscar Riddle, Sanitary Corps, has returned from France and resumed his duties at the Station for Experimental Evolution, Cold Spring Harbor, N. Y.

The National Research Council has appointed a committee to encourage research in colloid chemistry and to foster the training of more colloid chemists, consisting of the following: Harry N. Holmes, *chairman*, Oberlin College; Jerome Alexander, New York City; W. D. Bancroft, Washington, D. C.; G. H. A. Clowes, Eli Lilly Co., Indianapolis; W. A. Patrick, Johns Hopkins University, J. A. Wilson, Milwaukee.

Professor E. B. Van Vleck, of the University of Wisconsin, has accepted an invitation as lecturer on mathematics at Harvard University for the second half of the ensuing academic year. Professor Van Vleck will give, besides a course in the calculus, one on the theory of functions of a complex variable and on the partial differential equations of mathematical physics.

Dr. Arthur M. Jordan returns to the University of Arkansas this year as head of the department of psychology after a two years' leave of absence spent in research work at Columbia University.

Donald B. MacMillan, leader of the Crocker Land expedition, will be provided with a small schooner with auxiliary power, to be christened *The Bowdoin,* when he leaves next summer on his next Arctic exploration trip, according to plans of the alumni of Bowdoin College. The schooner will be built to withstand the pressure of icefloes. The party, about ten in number, will devote two or three years in exploration work for the National Geographic Society.

The Lane Medical Lectures, which are held biennially at the Stanford University Medical School, will this year be given by Dr. Alonzo Englebert Taylor, professor of physiological chemistry at the University of Pennsylvania. Dr. Taylor has been representative secretary of agriculture on the War Trade Board for the past two years, and his lectures will deal with the results of his nutritional and medical survey of European food conditions. The exact

date has not been definitely decided upon, but will be about December 12, 1919.

The French branch of the Ramsay Memorial Fund, which is to commemorate the work of the late Sir William Ramsay, is asking for contributions to a fund of one million francs (£40,000) for the purpose of founding Ramsay Memorial Fellowships in chemical science, similar to those to be founded in Great Britain, such French fellowships to be available for bringing to England for purposes of research chemists trained in the universities and technical colleges of France. An appeal is being made throughout France. The French branch, of which Mr. Lloyd George is president, includes among its committee M. Pichon, M. Deschanel, Lord Derby, Lord Hardinge of Penshurst, Lord Bertie, and Sir George Riddell. The cost of founding each fellowship will be £6,000. It is hoped by their means to enlist the influence of the universities of the two countries in promoting helpful international relations. The appeal in France is being directed specially to British and American residents there, and to the large number of persons of all nationalities who have for many months past been in France, while performing duties connected with the Peace Conference.

The current agricultural appropriation bill carries the following items, largely to be devoted to scientific research in applied agriculture:

Weather Bureau	$1,880,210
Bureau of Animal Industry	5,783,231
Bureau of Plant Industry	3,379,638
Forest Service	5,966,869
Bureau of Chemistry	1,391,571
Bureau of Soils	491,235
Bureau of Entomology	1,371,360
Bureau of Biological Survey	742,170

This reaches a total of $21,006,284 out of the entire appropriation to the Department of Agriculture amounting to $33,900,211. The growth of the sums expended in research work under the Department of Agriculture has been enormous of late years, and seems to have been fully justified by results:

UNIVERSITY AND EDUCATIONAL NEWS

The building for the Kansas University Medical School for which $200,000 was appropriated by the recent legislature, will be erected provided the city of Rosedale furnishes the additional ground needed, which is valued at $60,000.

Excavation has been begun for a $70,000 engineering laboratory at the Oregon Agricultural College. It will be a two-story structure 220 by 63 feet and of brick and concrete construction.

Mrs. Alice Jessie Sheppee has given £2,000 to Oxford University for the foundation of a scholarship in engineering science.

Dr. W. W. Charters, dean of the College of Education at the University of Illinois, has resigned to accept a position with the Carnegie Institute of Technology as professor of education to do research work in connection with curriculum organization and construction.

Dr. C. A. Fischer, of Columbia University, has been appointed Seabury professor of mathematics and astronomy at Trinity College, Hartford.

J. P. Fairbank, B.S.C., University of Nebraska, who has been assistant professor and acting head of the department of agricultural engineering in the college of agriculture at the State College of Washington, Pullman, Wash., has been promoted to professor and head of the department of agricultural engineering.

Dr. Charles W. Easley, head of the department of chemistry at the University of Maine, has accepted a chair at Syracuse University. He is to be succeeded at Maine by Dr. Charles A. Brautlecht, of the Florida State College for Women, Tallahassee.

Mr. H. M. Showman, of the Colorado School of Mines, has been appointed assistant professor of mathematics in the Case School of Applied Science.

Dr. Leonard Doncaster, F.R.S., has been appointed to the Derby chair of zoology in Liverpool University.

MR. G. G. HENDERSON, M.A., D.Sc., LL.D., has been appointed to be Regius professor of chemistry in the University of Glasgow, in the room of the late Professor John Ferguson.

DISCUSSION AND CORRESPONDENCE

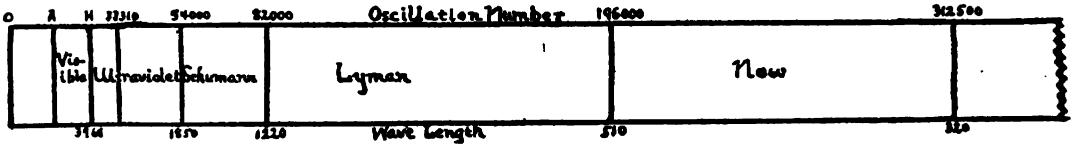
THREE FOURTHS OF AN OCTAVE FARTHER IN THE ULTRA-VIOLET

IN the *Physical Review* for August, 1918, Vol. 12, p. 167, we made a preliminary report upon a new method of obtaining grating-spectra in vacuo devised by one of us in the expectation of extending the limits of the ultra-violet spectrum. This report was made because both of us were engaged in war activities, and could not then push further the very significant results which we had already obtained—results which brought to light some 30 new zinc lines, the shortest wave-length among which had a value of 928 Ångstroms.

There is every reason to believe, however, that every element except hydrogen will emit line spectra corresponding to waves of higher frequency than this, the limiting frequency for a given element pushing farther and farther into the ultra-violet, the higher the atomic weight of the element.[1] With a properly chosen source therefore, the limit to the observable ultra-violet spectrum ought to be set solely by the properties of the grating and by those of the medium through which the radiation passes. Heretofore, it has been set by the limitations of the source and the properties of the absorbing medium. We felt that we had removed these limitations entirely by working in a very high vacuum with a type of source altogether new in vacuum spectrometry, and one which enabled us to use enormous energies in the highest attainable vacuum. In our preliminary report we stated that we had "indications of zinc lines of shorter wave-length than 928Å though no positive proof as yet."

Immediately upon release from the service we had a new grating constructed so as to obtain the maximum possible brilliancy, and a new and very efficient diffusion pump, so as to eliminate altogether, if possible, the appearance of all glow discharges and enable very high potentials (up to several hundred thousand volts) to be used in producing our hot sparks in vacuo. We hoped thus to bring up the intensities of the very short lines. We also eliminated from the vacuum chamber certain gas evolving bodies like ebonite which had appeared to limit our exposure times by reducing the periods during which we could operate our hot sparks without giving rise to glow discharges, and which in addition had very injurious effects upon our grating.

As a result of these improvements we are now maintaining an exhaustion of about 10^{-4} mm. of mercury while the arc is running. We have thus brought to light a considerable number of new zinc lines below 928Å of such wave-lengths as to add up to date three fourths of an octave to the ultra-violet spectrum directly accessible to study with a grating spectrometer. We shall be in position at a very early date to publish a series of actual photographs, but in this preliminary report will content ourselves with stating that we have ten definite reproducible zinc lines below 500 Ångstroms, the shortest having a wave-length of 320 Ångstroms. It is interesting to note by reference to the accompanying figure which is an extension of one given by Lyman[2] that this represents an extension in frequency of about four times that accomplished by Schumann, namely, 82,000 — 54,000 = 28,000, and a trifle more than that represents thus far in Lyman's work, namely,



[1] "The Electron, etc.," University of Chicago Press, 1917, p. 202.

[2] "The Spectroscopy of the Extreme Ultra-violet," Longman's, 1914, p. 105.

196,000 — 82,000 = 114,000, the new region representing the increase in frequency number (oscillations per centimeter) of 312,000 — 196,000 = 116,000.

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THE PROBLEM OF THE BOY IN THE SWING

IN the current issue of SCIENCE (p. 20), Professor A. T. Jones has given an excellent account of just how a boy works up in a swing. To solve a problem in physics qualitatively and experimentally and at the same time to keep the explanation clear and correct as Professor Jones has done is often much more difficult than to explain the same phenomenon quantitatively. Nevertheless, his last paragraph, dealing with the energy relations, aroused my curiosity to discover just what the equation is which connects the work done by the boy's muscles with the increased rotational energy of the swing.

What here follows is practically as old as Huygens and is well known, but may interest those who have read the note referred to.

If the distance of the center of gravity of the boy from the limb about which the swing rotates be denoted by r, his mass by m; and the angular speed of the swing by ω, then his angular momentum will be $mr^2\omega$. Suppose now that the boy who has hitherto been standing up in the swing proceeds to sit down upon his heels; then if his angular speed is to be maintained equal to that of a rigid pendulum (isochronous with the swing loaded with the standing boy and vibrating through the same amplitude) a torqe, L, must be introduced whose value, at each instant, is

$$L = \frac{d(mr^2\omega)}{dt} = 2mr\dot{r}\omega.$$

Or, if no such external torque be applied, then the boy's motion will be retarded, at each instant, by just this torque.

The tangential *force* which opposes the motion, as the boy moves away from the axis, will evidently be

$$F = \frac{L}{r} = 2m\dot{r}\omega,$$

a quantity which becomes zero whenever either the radial speed, $\dot{r}$, or the angular speed, ω vanishes. Except for very small angles of deviation, θ, this retarding force will be but a small fraction of the tangential component of the weight, $mg \sin \theta$, which is urging the loaded swing to its lowest point.

When the boy rises to a standing position, the sign of $\dot{r}$ changes and his motion, instead of being retarded, is accelerated. Here is where the kinetic energy of the pendulum is increased; and the amount of it, if ds be an element of length of the arc, will be

$$Fds = 2m\dot{r}\omega ds.$$

But since ω is much greater near the middle than near the end of the vibration, the boy will expend more energy in lifting himself at the bottom of the swing than he will gain in seating himself at the end of the swing; this quite aside from the fact that, at the lowest point, he works against the whole of gravity while at the maximum elongation only the radial component of his weight is effective.

To perform the actual integration of the above expression one would have to know—or assume—the rate at which the boy seats himself, *i. e.*, one would have to know $\dot{r}$ as a function of s.

The phenomenon is, of course, not necessarily associated with gravity. The same description would hold for a mass in radial motion along the spoke of an oscillating horizontal wheel—say, the balance wheel of a watch.

For the student of dynamics, the essential interest of the problem appears to lie in the general fact that, although a central force does not alter the angular momentum of a body about a perpendicular axis through the center, such a force will, unless balanced, affect the kinetic energy of the body. Any one who wishes to understand this fact will try for himself the simple pendulum experiment recommended by Professor Jones, no matter how vivid his boyhood recollection of

the forward thrust which always accompanied his rising at the bottom of the swing.

HENRY CREW

July 11, 1919

SCIENTIFIC BOOKS

The Evolution of the Earth and its Inhabitants. A series of Lectures Delivered before the Yale Chapter of the Sigma Xi during the Academic Year 1916–1917, by JOSEPH BARRELL, CHARLES SCHUCHERT, LORANDE LOSS WOODRUFF, RICHARD SWAN LULL, ELLSWORTH HUNTINGTON. New Haven, Yale University Press. 1918.

This volume of essays prepared at the suggestion of Professor Lull, as president of the Yale Sigma Xi, is an interesting and unique addition to the literature of the subject. Each lecture is a separate essay, the preparation of which involved considerable time, thought and original work. The first lecture by Joseph Barrell, whose loss too early in life we all mourn, is entitled: "The Origin of the Earth." It was especially fitting that Professor Barrell should give this lecture since his work on the age of the earth had drawn him into close touch with the astronomical and mathematical work involved in the problem of the earth's origin. The lecture reviews the various attempts to explain the origin of the earth, giving chief attention to the planetesimal hypothesis. The phase of the work on which Professor Barrell's own work bears is to be found in his discussion of "The Origin of Ocean Basins," "The Reign of Surface Processes and Beginning of the Archean." He closes his lecture with the thought:

> It is not known how close they (oldest Archean rocks) stand in point of time to the formative processes whose description has been attempted. With these oldest rocks, the dimly known, heroic and mythical eon of the earth is closed and the first historic eon opens as the remote and long enduring division of geologic time.

Professor Schuchert's lecture "The Earth's Changing Surface and Climate during Geologic Time" reviews in part the lecture of Professor Barrell pointing out the climatic features involved and extending Barrell's observations into the known periods of geologic history. The fundamental factor in climate is atmosphere, and Professor Schuchert's discussion of the "Origin of the Atmosphere" opens the problems of "Climates of the Past" which he is able to discuss so well because of his extensive studies in paleontology and paleogeography.

The "Origin of the Earth's Waters," "Source of the Salts of the Ocean" and "Origin of the Sedimentary Strata" give the reader the most modern ideas of these fundamental aspects of geology and lead up to the discussion of the changes in surface features which the earth has experienced in its evolution from a primordial mass to the recent. The discussion is accompanied by maps and tables explaining in a graphic way the thoughts of the lecture. Professor Schuchert is inclined to the view that geologic time has endured about 800 million years, supporting the ideas of Matthew, Shapley and Barrell from other evidences.

Professor Woodruff in his lecture on "The Origin of Life" has attacked a much more difficult problem because of the great dearth of evidence or analogy. He has handled the difficult task cleverly in discussing, first the nature of protoplasm, the individuality of organisms, and by giving an interesting historical account of "The Theories of the Origin of Life" under the following titles: "Vitalism," "Cosmozoa Theory," "Pflüger's Theory," "Moore's Theory," "Allen's Theory," "Trolands Enzyme Theory," "Osborn's Theories." It is rather disappointing to have Huxley and Darwin close this lecture, since it would have been extremely pleasing to know what Woodruff himself thinks about the "Origin of Life," and his research work has certainly given him some idea on this interesting topic.

No one could speak with more knowledge of facts as to the "Pulse of Life" than Professor Lull in the fourth lecture.

> The stream of life flows so slowly that the imagination fails to grasp the immensity of time required for its passage, but like many another stream, it pulses as it flows. There are times of quickening, the expression points of evolution, and

these are found to be coincident with geologic change.

The lecture might well have been called "The Philosophy of Paleontology," though the evidences are drawn chiefly from the vertebrates, the discussion being illumined by a very interesting diagram of the pulse of life, showing the influences of climate, continental elevation, and extinctions on the pulsations of vertebrate life. The discussion follows such interesting topics as "Emergence of Terrestrial Vertebrates," "Evolution of Terrestrial Foot," "Origin of Reptiles" and closes with the interesting comparison of the graph produced by a sphygmograph, recording the movements of the human pulse, with the graph deduced from the study of geologic and paleontologic evidences, recording the pulsations of life through many millions of years.

In the closing lecture of the series Professor Huntington discusses "Climate and the Evolution of Civilization." This is a proper closing for such a series, thus bringing out the influence of physical factors in the highest form of evolution. The lecture discusses the influence of climatic influence on certain primitive tribes and nations of America and is illustrated by a number of climographs.

The volume is thus a discussion, in brief form, of the chief factors bearing on the evolution of the earth and its inhabitants from the cosmical origin to the culmination of the highest phylum in the production of a high type of civilization.

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SPECIAL ARTICLES

A PRACTICAL LONG-PERIOD SEISMOGRAPH

A seismograph which is to record earth-motion with fidelity must have a "steady point" which shall be uninfluenced, as nearly as may be, by that motion. In existing instruments this steady point is the center of oscillation of a mass so suspended that when disturbed it vibrates slowly about an equilibrium position. The relative motion of the ground with reference to this steady point is then recorded with magnification on a sensitive surface by means of a suitable optical or mechanical system.

With suitable damping, and with a faultless recording system, the resulting record has considerable accuracy for rapid seismic motion whose period is not greater than the free period of the instrument; for slower motion the accuracy declines rapidly; and the instrument is wholly insensitive to motion whose period is several times greater. It is therefore of prime importance that the period of the instrument shall be as great as possible.

When this period is made large, however, a difficulty arises in that the equilibrium position of the heavy mass changes slowly, due to tilts of the support in case of the horizontal pendulum, to temperature changes in the vertical-motion instrument, and in both due to other less important causes. With the ordinary method of recording, these slow wanderings are magnified in the record, increasing the technical difficulty of obtaining the record, and excessively increasing the size of sensitive surface required. For these reasons practical seismometry has limited itself to periods rarely exceeding twenty seconds.[1]

Galitzin was the first to employ a method which permitted the recording of seismic motion without registering the wanderings. He employed an electromagnetic system which depended upon the velocity of the earth-motion rather than upon the displacement, thus avoiding the slow changes. In doing this, however, he sacrificed the flatness of the magnification curve of his instrument, so that his record not only did not represent the seismic motion directly, but did not permit its computation except in the case where such motion was simply harmonic—a case which does not occur in practise.

The writer has devised a method of record-

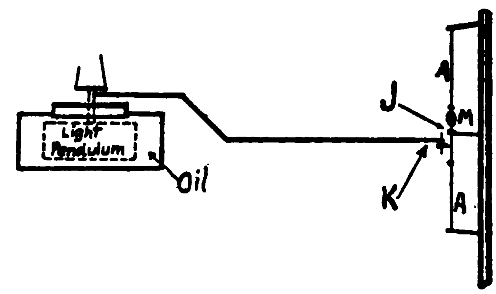
[1] From the literature one might infer that in practise, there is a low upper limit to the period of the horizontal pendulum. Walker sets this limit for laboratory purposes at forty seconds. But Omori has achieved much longer periods. The first pendulum constructed by the writer in the College of Hawaii laboratory had a period of three minutes.

ing which ignores the objectionable slow wanderings of the heavy mass, and yet records displacements directly, retaining the flat magnification curve of the best seismographs, and permitting the use of very long-period instruments. The essential feature of this recording system is that the (apparent) motion of the heavy mass is transmitted through a viscous medium to a light system having a shorter period of its own: the viscous coupling amounting to direct connection for the seismic motion of a period up to that of the pendulum, but permitting the light system to avoid the very slow changes.

This method of recording may be explained by describing the system as applied to a certain horizontal pendulum at the College of Hawaii. The adaptation to vertical-motion instruments will suggest itself.

Attached to the seventy-pound mass of a suitably damped horizontal pendulum is a horizontal cylindrical vessel of heavy oil, the axis of the cylinder being in the direction of motion of the pendulum. The cylinder is two inches in diameter, and has an opening in the form of a longitudinal slit one half inch wide at the top, around which there is a rim, to allow the surface of the oil to be somewhat higher than the top of the cylinder. In the cylinder, immersed in the oil, is the mass (about one pound) of a second horizontal pendulum. This mass is itself cylindrical and forms a piston within the larger vessel, though not touching it. The axis of rotation of this light pendulum coincides approximately with that of the heavy pendulum, but is sufficiently inclined to give a free period short enough to allow of registration, and it is the motion of this light pendulum which is recorded. It will be seen that for ordinary seismic motion the two pendulums form a single mass, but that the oil can flow so as to allow the light pendulum to retain approximately its own equilibrium position.

Registration is accomplished photographically as follows: A piece of no. 36 nickel wire two inches long is soldered at its ends to pieces of galvanometer suspension ribbon *AA* (see figure) each three inches long, and stretched between spring supports in a vertical position. At its middle this nickel wire passes through the hole of a watch jewel *J* of suitable size held by an arm fastened to the support, preventing transverse vibration. Fixed to the nickel wire just below the jewel is an arm of wire, one fourth inch long, holding at its other end a similar jewel. Through the hole of this jewel passes a short piece of no. 36



wire *K* attached to the end of an aluminum wire which is itself attached to the light pendulum by a flexible connection. The motion of the pendulum is thus transmitted to the mirror *M* which is cemented to the nickel wire at another point. The rocking of the mirror is recorded in the usual way on bromide paper.

This system succeeds with a magnification of 75 on a pendulum moving sometimes half an inch in the course of the twenty-four hours, with a lateral drum-motion of an eighth inch per (hourly) revolution.

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CONTENTS

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THE RESPONSIBILITIES OF THE SCIENTIST[1]

LITTLE more than two years ago, the American man of science was in his laboratory, busy with the problems of research. The possibilities of progress were never greater, and the obligation to exceptional effort, for the purpose of assisting to retrieve some of the heavy losses suffered by science through the war, was constantly before him. But the perennial attractions of research and the strongest desire to advance science were insufficient to hold his attention. He watched with indignation the piratical attacks of the submarine, the brutal invasion of provinces and states, the unspeakable horrors of the German advance. Undeceived by specious pleas for peace, he recognized the clear duty of the United States, and chafed at repeated delays when quick and determined action would have saved countless lives. And when, at last, we entered the war, he eagerly grasped any opportunity for service that came to him. Sometimes the opportunity did not come, and he then accepted the more difficult, but no less obvious, duty to persevere in his researches and thus to preserve the continuity of scientific progress.

The experience during the war of the man of science has sometimes been confusing, and it is possible that his responsibilities on the return of peace will not always be clearly recognized. Men who have previously devoted their lives to the advancement of knowledge have suddenly been called upon to solve practical problems, of the greatest military or industrial importance. In attacking these new questions, they have shown remarkable powers of adaptation, and surprise has often been

[1] Read before the Pacific Division of the American Association for the Advancement of Science, as a part of a symposium on "Scientific Education in a Democracy."

expressed that they could turn so readily from fundamental researches for the increase of knowledge to the most intensely practical undertakings.

But a moment's consideration will show how easily the change has been effected. An eminent physicist develops a new range-finder, which is adopted by the navy because of its superiority to any existing instrument. But what could be less surprising, in view of his life-long success in devising new optical instruments for physical research?

Several men of science, working in close cooperation, effect great improvements in a device for accurately locating invisible submarines, even when completely at rest and emitting no sound. But the fundamental principles and methods involved in this war research are precisely the same that these investigators have employed for years in their electrical and astronomical investigations. And so I might go on, mentioning scores of important war services performed by physicists, mathematicians, chemists, astronomers, meteorologists, geologists, botanists, zoologists, bacteriologists, anthropologists, psychologists and investigators dealing with every branch of science, whose previous efforts have been wholly devoted to the advancement of knowledge.

Some of these men, when seriously reflecting upon their responsibilities at the close of the war, have hesitated to return to their old tasks. They have often been applauded, by those who know nothing of research, for their newly-discovered ability to accomplish "practical" results, and to contribute in this obvious way to the public welfare. Or they have been offered by the industries salaries far in excess of those they receive from the university or technical school. Which way shall they turn? How may they best serve the world?

These questions have been clearly answered long since, not only by students of science, but no less emphatically by great leaders of industry. No American engineer stands higher than J. J. Carty, vice-president of the American Telephone and Telegraph Company, recently colonel in the Signal Corps, in charge of our lines of communication in Europe. In his address as president of the American Institute of Electrical Engineers, after showing that the industries, through self-interest, will provide amply for industrial research, Colonel Carty dwells on the importance of fundamental researches in science, and remarks:

> By every means in our power, therefore, let us show our appreciation of pure science and let us forward the work of the pure scientists, for they are the advance guard of civilization. They point the way which we must follow. Let us arouse the people of our country to the wonderful possibilities of scientific discovery and to the responsibility to support it which rests upon them, and I am sure they will respond generously and effectively.

Or take the word of W. R. Whitney, director of the great industrial laboratory of the General Electric Company:

> Necessity is not the mother of invention; knowledge and experiment are its parents. This is clearly seen in the case of many industrial discoveries; high-speed cutting tools were not a necessity which preceded, but an application which followed, the discovery of the properties of tungsten-chromium-iron alloys; so, too, the use of titanium in arc lamps and of vanadium in steel were sequels to the industrial preparation of these metals, and not discoveries made by sheer force of necessity.

Or remember the statement of Huxley:

> I weigh my words when I say that if the nation could purchase a potential Watt, or Davy, or Faraday, at the cost of a hundred thousand pounds down, he would be dirt-cheap at the money. It is a mere commonplace and everyday piece of knowledge that what these men did has produced untold millions of wealth, in the narrowest economical sense of the word.

How true this is, how directly the greatest practical advances are dependent upon researches made solely for the advancement of knowledge, without any thought of immediate application, is well illustrated in the case of wireless telegraphy. The existence of waves in the ether, much longer than those that give the impression of light, but traveling with the same velocity, was first definitely shown by Maxwell, in his purely mathematical investigations on the electromagnetic theory of light. For twenty years these waves were known only in his equations, but in 1888 Hertz found

that they were actually emitted by a spark in his laboratory, and could easily be detected across the room and at greater distances. This made wireless telegraphy possible. Afterwards it was only a question of perfecting the transmitting and receiving devices in order to increase their range. This was no light task, and we owe much to Marconi and others for accomplishing it. But it is plain that wireless telegraphy could not have been even imagined before the discovery of electric waves in the ether by Maxwell and Hertz.

Some advances in science are less direct in their application, but even more significant. Of what benefit to the world is astronomy, the oldest of the sciences? I need not dwell on its obvious applications in the measurement of time, in accurate surveys of the earth's surface, in the determination of positions at sea. These uses render astronomy invaluable, but they do not represent its greatest contribution to the world.

To appreciate this, we must turn to the pages of Henri Poincaré, in his little book on "The Value of Science." The basis of scientific progress is law, and we owe the conquest of law to astronomy. Where would our modern civilization be, asks Poincaré, if the earth, like Jupiter, had always been enveloped by clouds? Our remote ancestors were creatures of superstition, surrounded by mysteries, startled at every display of incomprehensible forces, accustomed to attribute all natural phenomena to the caprice of good and evil spirits. To-day we no longer implore the aid of nature: we command her to do our bidding, because we have learned some of her secrets, and are constantly solving others. We command her in the name of laws which she can not repudiate, because they are her own. Recognizing, as we do, the unchangeable basis of these laws, we do not foolishly demand that they be changed, but submit ourselves to them, and utilize them to the advantage of mankind.

Astronomy taught us the existence of the laws of nature. The Chaldeans, first to observe the heavens attentively, perceived harmony of motion and sequence of phenomena. Day and night, the round of the seasons, the phases of the moon, the periodic wanderings of the planets, held their attention and encouraged their study. Their work was continued by the Greek astronomers, who discovered rule after rule with the simple instruments at their command. Tycho Brahe, Copernicus, Kepler and Galileo pushed forward the advance at an accelerating rate, until Newton finally announced the oldest, the most accurate, the simplest and the most general of all natural laws.

Encouraged by these never-ending successes, students turned their attention to the phenomena of the earth's surface, and found in their apparent disorder the same harmony and the same reign of law. But the infinite variety of nature, the conflict of forces, and the extreme complexity of terrestrial phenomena would have greatly delayed progress if the simple and easily-discovered rules of the heavens had not pointed the way. Faced with discouragement, the physicist or the zoologist could fall back upon the assurance, which astronomy had repeatedly afforded, that nature does obey laws. Their task, therefore, was to discover these laws, and to persist in their endeavors until the difficulties had been overcome.

I wish that time permitted me to follow Poincaré further and to show how the world's debt to astronomy rests not merely upon her initial discovery of natural laws, but also upon her proof that these laws, once accurately determined, are unchangeable through the centuries, and that they apply in every part of the visible universe. I might also show how Copernicus and Galileo, when they demonstrated that the sun and not the earth is at the center of our system, smashed into fragments the medieval mode of thought, and reestablished the true methods of science, previously used in more restricted form by the Greeks. If it were still maintained that the task of astronomy has been accomplished, I might point out that only yesterday it demonstrated that the elements and some of the compounds of the chemist are not confined to the earth, but are present in the most distant stars, and that the latest developments of electrical theory and the most recent investigations on the nature of matter are tested by

observations of the sun, stars, and nebulæ. And I might add, if I thought it would strengthen the argument, that the light gas helium, which was first produced on a large scale during the war, and would have rendered the great bombing dirigibles of the Allies practically safe over Berlin, because of its non-inflammable and non-explosive character, was discovered in the sun a quarter of a century before it was found on the earth.

But I have said enough, I hope, to convince you that astronomy has been of real service to the world, and that its study should be continued, especially in this prolific period when our understanding of the extent and nature of the universe is advancing more rapidly than ever before. And if the present duty of the astronomer to advance the knowledge of his science is plain, that of the investigator in every other field is equally so. He should go back to research, with new vigor and redoubled energy, without troubling himself for a moment with the question of immediate practical return.

Industrial research must be enormously developed in the United States, and the old distinction between pure and applied science must be swept away.[2] But once awakened, as they already are, the industries may be trusted to follow the example of the duPont Company, which began with five research chemists in 1902, and spent three millions in their research laboratories during 1918. The task of the educational institution and of the private research foundation under such conditions is a tremendous one. They must not only develop investigators capable of doing the work of the industries, as the German universities have done for so many years; they must also push forward, on a far greater scale than ever before, their researches for the advancement of knowledge. Only thus can the highest advantage of science and industry, the chief interests of public welfare, and the greatest national progress, be attained.

GEORGE ELLERY HALE

MOUNT WILSON OBSERVATORY

[2] See Hale, "The National Engineering Societies and the National Research Council."

THE PRESS AS AN INTERMEDIARY BETWEEN THE INVESTIGATOR AND THE PUBLIC[1]

IT it with some diffidence that as a rank amateur I accept the invitation of so learned a body to make any suggestions even upon that branch of your work upon which we are all amateurs. But perhaps just because it is a question, not of the discovery of truth, but of the promulgation of that truth to the unprofessional public, there may be some advantage in approaching it from the standpoint of a mere member of that public.

I am not sure that there is unanimous or immediate consent to the doctrine that any merely popular intermediary between the investigator and the public is even desirable. Certainly there has in the past been enough of aloofness on both sides, for which neither side has been guiltless. Even where science has not inherited the jealous exclusiveness of a professional guild, the original investigator had had temptation enough to remain aloof from the public. If his discoveries were of any practical use, others would advertise them soon enough. If they merely opened wider the portals of truth, the public was little interested, and there would be time enough for its enlightenment when the ponderous monograph became a sentence or a footnote in the elementary text-books. Besides, it seemed so hopeless to give the public what it ought to have, and so worse than useless to give it what it wanted. The whole mental viewpoints were different. The scientist is cautious, accurate and impersonal. He uses his imagination, not to jump at conclusions, but as a guide to experiment and investigation. He hesitates to announce a discovery until he has fully verified it, and then he limits himself strictly to the one step he has taken into the Unknown, and avoids flights of fancy into its speculative possibilities. If his knowledge is fragmentary, he refuses to fill out its gaps, and he is resolutely non-committal on what he does not know. He cultivates an imper-

[1] Read before the Pasadena Division of the American Association for the Advancement of Science, June 20, 1919.

sonal impartiality, and even on a controverted question he would scorn to win a victory over an opponent by misstating or understating that opponent's position or evading any of the evidence for it. The public, on the other hand, demands cocksureness, especially on all the consequences which a discovery suggests to the imagination. It is intensely personal, and inquires first what use it can make of the discovery, or whether it confirms or opposes its prejudices. It undervalues accuracy, overvalues vivid picturesqueness, and does not understand impersonality or impartiality at all. It jumps at conclusions, and refuses to take "I don't know" for an answer. How shall the scientific man condescend to such a rabble without losing his soul?

The public, on its side, is as little ready to appreciate the scientist. Personally, it regards him as a freak. If he happen to have the personality that would be valuable to a business man—an impressive presence, an aggressive, decisive manner and the executive temperament which decides everything instantly and positively and sees that it is done—he may be respected for these qualities. But if, as is usually the case, he is not chiefly notable for these qualities, he is regarded as an "impractical dreamer," who may, by some hocus pocus, produce miracles from his magic box, but is personally entitled to no consideration. Then there is the persistent illusion of "book larnin'." Because most of the elementary education with which the public is familiar is derived from books, it is assumed that higher learning is also derived from books, and that a "professor" is merely a man who has stuffed his brain with many books. The books themselves are taken as ultimate facts, and the question, Who wrote the books? or, Where did he find out the things in them? never occurs to the mind. Even the great classics of science, like the "Origin of Species," are conceived after the analogy of the classics of theology, and Darwin may be assumed to have propounded his alleged dogma that "man descended from the monkey" much as Calvin propounded predestination or Wesley the direct conviction of salvation. And if there come rumors that some one—de Vries, for instance—has "disproved Darwinism," it is at once assumed that he is merely the leader of a new sect with a different creed. As to the strange jargon in which scientists are wont to express themselves, that is merely funny. Anyhow, scientists are a rather contemptible tribe. For if there is anything more contemptible than not knowing the particular thing I know, it is knowing something else that I do not know. It is by this compensatory contempt for the knowledge of others that we retain our self-respect in the face of our ignorance.

And I may suggest that the breaking down even of this merely personal barrier between the scientist and the layman is of immense importance to our American democracy. For our most grievous lack, as a people, is our ignoring of experts, and our fiction that "any man is fit for any job." The one German lesson which we must not permit the war to unteach us, but which it must rather emphasize a thousand fold, is the lesson of valuing and trusting the expert. It was by the misuse of the efficiency which this lesson taught her that Germany was able to stand off the world for four years, and nearly succeeded in destroying the civilization which her science had helped upbuild. If we should jump at the mad conclusion that the things which proved dangerous in the hands of autocracy for the destruction of civilization shall therefore not be used by democracy for its upbuilding, we might inflict on the world an even greater damage than that wrought by German arms. It is therefore the duty of the American expert, even at the cost of some repugnant self-exploitation, to make himself personally respected by the democracy. And he can not do that in his laboratory and through the scientific journals alone.

For any large-scale contact with the general public, the popular press is indispensable. This press may be divided into three groups—the daily newspapers the Sunday newspapers and the popular magazines.

By far the most efficient organ of publicity is the daily newspaper. Everybody reads the

newspaper every day, and most people read nothing else. Therefore, whatever of scientific truth or of the scientific spirit you can get into the daily newspaper will reach farther than it can do in any other way. But it is necessary to realize the narrow scope and the fixed perspective of the newspaper. The daily newspaper deals in just one thing—in news. If you see anything else in the paper, you may be sure that it got there under protest, as a regretted necessary evil. What is news may not be easy to define, but we may indicate it negatively by pointing out what it is not. In the first place, things are not printed as news because they are useful or useless, beneficial or injurious. You can not get anything into the paper by proving that it would be beneficial or useful, nor keep anything out by proving that it might be useless or injurious. Also, the eternal verities are not news, though a temporary and adventitious fact regarding them may be. And a thing which is news here today is quite likely not to be news to-morrow and elsewhere. The space and time element absolutely dominate the news. In fact, that may be made a handy negative test of news. The surest way to know that something ought to be printed in to-day's paper is to show that it would be absolutely unthinkable to print it in yesterday's or tomorrow's paper. And the news must be so attached to a particular place and person that it would be ridiculous to attach it to any other place or person, or to omit the place and personal element. If you can write a scientific truth so that the principal statement of it shall be in the first sentence, and the most important words in that sentence are "here," and "to-day," and your own name, and especially if you can so write it that it would be absurd to date it at any other place, on any other day, or with any other name, then you can probably get it into the newspaper. And after you have accomplished that one sentence, which makes it news, it is astonishing the amount of eternal verity you may append thereto, and still "get by" with it. But don't attempt to exploit the eternal verities on their own merits. They are not newspaper merits.

The second condition of news is, of course, human interest. *News is any humanly interesting thing, which happens in some particular place, to-day.* Very many subjects of scientific investigation, including some things of educational value as to scientific method, come within this definition. Professor Ritter's investigations of the relation of sea temperatures and rainfall, or of the migration of food fishes, have intense human interest, and if it can be stated that "Professor Ritter discovered, at La Jolla, to-day," or "announcement was made, at La Jolla, by Professor Ritter, to-day," then the time, place and personal factor are added, which make them news. Most of the chemical investigations of the war, at whatever date they can be announced, are intensely interesting news—the synthesis of glycerine from sugar, for instance; the extraction of rubber from desert shrubs, or the development of new and rare metals. The beginning and the end of the kelp industry, and the belated announcement of war by-products, are news—the day they happen or are first given out. The human facts regarding the service of scientific experts to the war are news, when given out. The war has made chemistry respectable, to the popular imagination, just as the discovery years ago, by Professor Walter Dill Scott, that psychology would make money in advertising made psychology respectable. Even astronomy has rendered enough service in this war to make it respectable, if the facts were given out.

Scientific methods seem particularly hard to make news of, but our agricultural scientists have succeeded in doing it. The one thing necessary, to gain the confidence of the practical farmer in the farm adviser, was to remove the illusion that the farm adviser was a book-learned man. When the farmer learned that the farm adviser found out things the same way he did, only more systematically and more exactly, then his knowledge became respectable. By trying practical experiments, in places where they became news; by collating practical results from their application; by putting a sporting interest into pig clubs; by making speeches at farm meetings and get-

ting them into the newspapers (a speech is news, when it is delivered, even if it is about the eternal verities) the farm advisers, as the outposts of agricultural science, have largely solved the problem which the rest of you are facing, of bridging the gap between the scientist and the people.

Medical science, because it is subject to hostile controversy stands particularly in need of publicity, not merely as to its results, but as to its methods. There is a popular delusion that the established facts of medical science are sectarian dogmas, deniable by any one who chooses to propound the contrary dogma. The isolation, therefore, of a new disease germ means nothing to the reader who "does not believe in the germ theory." But if the facts are given out that this germ, isolated from patients sick of the disease, was cultivated for many generations outside of the body, was inoculated in susceptible animals and uniformly produced the disease, and was finally tried on volunteer men and produced the disease in them the knowledge of these facts, which have of course been commonplaces of scientific methodology since Koch, will increase popular confidence in the soundness of medical conclusions, by showing the soundness of the methods by which they are reached. But this sort of publicity is frequently prevented by scientific squeamishness. For instance, army research laboratories, during the recent influenza epidemic, succeeded in isolating the bacillus of Pfeiffer from most of the cases, at least in the early part of the epidemic. I know of at least one such laboratory in which inoculations of fifty volunteer men with pure cultures was followed by clinical influenza in forty-eight, with incidental pneumonia in four or five cases. These results were never given out. But in a certain army hospital, twelve soldiers had their noses sprayed with what was said to be a pure culture of some influenza bacillus, with negative results. This result was given out and got on the wires. The result was that every apostle of medical unorthodoxy in America had a clipping in his pocket, giving this alleged demonstration that influenza is not a germ disease. Nothing will counteract this sort of propaganda, but the truth, promptly, unsqueamishly and if necessarily immodestly proclaimed.

But I have gone on too long on my favorite subject of the daily newspaper end of the subject. Let us consider the still more shocking problem of the Sunday newspaper.

Because of the great amount of advertising in the Sunday newspapers, it becomes necessary to print an excessive amount of reading matter, to float that advertising. The news, as the more buoyant medium, is spread as far as it will go, but it is not enough, and for the rest the newspapers have recourse as a last desperate resort, to literature, science and the arts. Being regarded with contempt, as rubbish in comparison with the news, naturally the standard of selection of these unavoidable evils is far from idealistic. I am not recommending the literature of the "Sunday Sup.," and I share your horror of most of its science. But the point is that there is a page of science there, and where bad science is, surely good science might go. It must, to be sure, be well "yellowed up." If a disease germ can be attached to some well-known man or a geological truth to some recent calamity, so much the better. And it will not do to banish entirely the speculative imagination. May not the rumors of the sea serpent be based on the survival of some monster of a former age? How would the earth look to the inhabitants of Mars, if there are any, and what chest measure would they have to have to breath its thin air, and how high could they jump? Can the creatures of the abyss teach us the mystery of cold light? Can synthetic chemistry feed mankind when the earth becomes too overpopulated for animal and vegetable food? These may be childish questions, but at least it is better to answer them with truth than with falsehood. And if the scientist will bring himself to realize the primary importance of the picturesque and the human interest, as unlocking the key to the "Sunday Sup.," he can then at least do something toward keeping scientific nonsense out of this the most widely circulated of all scientific

publications, and he may do something toward getting scientific truth into it.

May I also add just a word on political science?

It is one of the calamities of democracy that most economic and social problems are first worked out by experts, who embalm their results in books which are interred in university libraries, and are then, long after, worked out by rule of thumb, by practical politicians and business men. One of the supreme problems of our universities is to bridge this gap.

Of the popular scientific magazines, I scarcely need speak. You know them better than I do. But do they need to appeal so nearly exclusively to the mechanical curiosity of boys? Some magazines, like *Good Housekeeping,* are doing excellent work in popularizing dietetic science among women. Is there not some way to penetrate the indurated intellects and the atrophied imaginations of our adult men, also?

I realize that I have added little to your knowledge of any subject, by these desultory remarks. May I hope, however, to have aroused at least a little unscientific curiosity?

Chester H. Rowell

EMIL FISCHER

The news has just reached us that Emil Fischer is no more. Since the fateful August, 1914, Germany has lost her Ehrlich, her Buchner, and her Baeyer; England, her Ramsay, Crookes and Moseley. Deaths occur, wars or no wars; yet Buchner might have lived had not a shell cut short his existence; and young Moseley had barely started along his brilliant career when he, like the promising Rupert Brooke, laid down his life for his beloved England. Ramsay's end, we know, was hastened by manifold war duties. To what extent Fischer was a victim of the war is still unknown to us; but we were told, from time to time, of his violent pan-Germanism, doubtless encouraged by the exalted position he held under the crown. The magnitude of Germany's *débâcle* would have crushed a spirit less proud than *Geheimer-Regierungsrat* Fischer.

What ever opinions we may have regarding Fischer's political affiliations there can be no question of his position in the history of chemistry. His bitterest enemies are the first to pay tribute. He easily takes his place among the greatest organic chemists of our generation.

To appreciate his work a little more we must look into the state of the science when Fischer began his labors.

That animal and vegetable life were largely made up of carbon compounds, that the food we eat could be largely divided into fat, proteins and carbohydrates—all this was known. If, then, a knowledge of the composition of these substances, as truly belonging to organic chemistry as marsh gas or benzene, was vague and wholly unsatisfactory, this was due to the complexity of their make-up. Chevreul and Berthollet had largely cleared the situation in so far as the fats were concerned, but the chemistry of the carbohydrates, and particularly that of the proteins, remained as mysterious as ever. The three foodstuffs were the borderland where chemistry ended and biology began; the lack of a solution of the composition of at least two of these foodstuffs left the finishing touches of the edifice of organic chemistry still undone, and gave a wholly unsatisfactory foundation for the science of physiology.

To the solution of this problem Fischer pledged his life while still a student, and brilliantly did he fulfil his life's task. With an imagination tempered only by a splendid scientific training, an originality of mind which made a lasting impress upon every piece of work with which he was associated, and a rare skill in devising apparatus, he, first by his own labors, and

later, as director-general of an army of aspiring students, gradually unfolded the mysteries that had enshrined the most complex chemical substances known to man. Like all great contributions, his had added not only to our chemical knowledge but has shed a flood of light on cognate sciences, such as botany, zoology and physiology.

Fischer was born in Euskirchen, Rhenish Prussia, on October 9, 1852. His father, Lorenz Fischer, was a successful merchant whose success in business must have made a deep impression upon his son, for Emil, after matriculating the gymnasium in Bonn, joined his father's concern at the age of seventeen.

This enthusiasm for the commercial world, however, was short lived. Within two years he had abandoned all thoughts of high finance, and had inscribed himself as a student at Bonn University. Kekulé, one of Van't Hoff's teachers, was the professor of chemistry, and Engelbach and Zincke were his active assistants. Fischer came in contact with all three.

The ill-omened Franco-German war had barely terminated when the German government decided to found a university at Strassburg. To this place, in the autumn of 1872, Fischer, true to the German student's traditions, came to spend part of his *Wanderjahre*.

By the end of a year Fischer was ready for the next step in the training of a chemist—a course in organic chemistry. This brought him in contact with Adolf von Baeyer, the professor of the subject.

Fischer immediately came under the spell of Baeyer. The professor was rapidly reaching the height of his intellectual output. His amazing mastery of every phase of the subject, the keen criticism to which every piece of work was subjected, the fertility of his ideas, combined with the fatherly care he took of his "children," the students, made Baeyer very popular with his assistants and research workers, not least of all with Fischer.

In July, 1874, Fischer completed an investigation on the coloring matters fluorescein and orcin-phthalein, for which he received his Ph.D. His immediate appointment to an assistantship was evidence that he had already made an impression upon Baeyer, whose faculty for detecting promising material was not the least of his gifts.

In less than a year Fischer, with his discovery of phenylhydrazine, forged to the very front rank of organic chemists. Later this substance in his hands proved the most effective tool in synthesizing the sugars, which are the typical members of the carbohydrate family. To-day the *osazone* test for sugars, a test depending upon the use of this same phenylhydrazine, is among the commonest and the most effective methods used by the chemist, the physiologist, and the clinician for the isolation and detection of the sugars.

Little wonder, then, that when Baeyer in this same year was selected to succeed Liebig, in Munich, he was desirous that young Fischer should accompany him. This, of course, was just what Fischer wanted.

For the next three years Fischer held no official position at the University of Munich. As events proved this was the most fortunate thing that could have happened.

With phenylhydrazine as the starting point, the various derivatives of this parent substance were investigated, and its relationship to the *diazo* compounds was clearly established. The ease with which the phenylhydrazine combines with other substances gave rise to an almost endless series of new compounds. To us of par-

ticular interest is its combination with two important classes of organic compounds known as the *aldehydes* and *ketones*—a discovery which found direct application in the chemistry of the sugars.

At the same time, Fischer, in collaboration with his cousin, Otto Fischer, began an investigation of the rosaniline dyestuffs—the magenta of Perkin—which terminated in the brilliant discovery that these dyes were all derivatives of a base *triphenylmethane*.

Fischer was made *privat-docent* in 1878 and at the end of the year was promoted to the extraordinary professorship and given entire charge of the analytical department in Baeyer's laboratory.

Then began those classical investigations into the active constituents of coffee and tea, caffeine and theobromine, and their relationship to xanthine and guanine—decomposition products obtained from the protein in the nucleus of cells—which ultimately opened up an entirely new chapter in plant and animal chemistry.

In the Easter of 1882 Fischer accepted a call as full professor (*ordinarius*) to Erlangen, and three years later be exchanged this chair for one in Würzburg.

After many weary trials, Fischer managed to synthesize the most important sugars—among them fruit and grape sugar—and also to prepare many new ones artificially. It was in the course of this intricate and laborious work that he had occasion to put Van't Hoff and Le Bel's theory of the asymmetric carbon atom to exhaustive tests, with results which established the theory more firmly than ever.

It was also during these epoch-making experiments on the sugars, when phenylhydrazine found constant application, that Fischer began to suffer with chronic poisoning, due to the inhalation of the vapors of this substance. Its effects he never got rid of, and from then on he was more or less of a semi-invalid. This might perhaps explain why in after years students found him somewhat of a "grouch" and quite unapproachable. The testimony of some of his students at Würzburg seems to bear conclusive witness to the fact that in those days, at least, he was not only an inspiring leader and lecturer, but took a very active interest in his research men.

The appointment to a full professorship made feasible his marriage to the lady he had long courted, *Fräulein* Agnes Gerlach. The two made a striking pair. Both were tall and handsome, with intellect and wit aplenty. Their son has faithfully followed in his father's footsteps.

In 1892 came the crowning event of his career. A. W. Hoffmann, who had been professor at the Royal School of Chemistry in London for some years, and had there taught such men as Crookes and Perkin, and had later been appointed to the chair of chemistry at Berlin University, died, and Fischer was selected to succeed him.

In Berlin Fischer continued his work on the sugars. The fact that many of these bring about fermentation led Fischer to fruitful studies on the possible constitution of ferments and their relationship to the substances they act upon.

Fischer's synthetic work in the sugar series, particularly his studies into the configuration of cane sugar, maltose and lactose received a great impetus from the success which attended his efforts in preparing glucosides—combinations of glucose and one or more other substances—artificially. By the study of emulsin and other enzymes in yeast on such glucosides, Fischer found that the slightest change in the configuration of the glucoside inhibited the action of the enzyme. Zymase, another enzyme in yeast, which is directly responsible for the conversion of glucose into alcohol, behaved

similarly. This led him to the conclusion that a close chemical relationship exists between the enzyme and the substance on which it acts—a view which led to his famous analogy of the lock and key relationship. Just as one key fits one lock, so any one enzyme will act on only a certain type of substance.

In the winter of 1894 Fischer resumed his earlier work on uric acid and caffeine. After three years he succeeded in synthetically producing every constituent of the group, and traced them all to a mother substance to which he gave the name of *purin* (a word suggested by the phrase *purum uricum*).

The chemist, the physiologist and the pathologist can but wonder at such genius. Here are the most complex and the most important class of protein bodies, the so-called nucleoproteins, which, as their name implies, are found in the nucleus of the cell, and which, in the course of their decomposition in the body, give rise to *xanthine, hypoxanthine, adanine, guanine, etc.*—all typical purines. Here are these purines which, in their further travels in the body, come to the liver, where a larger percentage of them are oxidized to uric acid—another member of the purine family. This same uric acid is a never-failing constituent of the urine, and its quantity gives valuable data regarding nucleoprotein metabolism in the body. This becomes of paramount importance in such a disease as gout. The inter-relationship of these complex purines, as well as their relationship to plant analogues, such as caffeine and theobromine, have been as thoroughly probed by Fischer as the composition of water or that of air. He has gone even further. Having found relationships, and having traced the substances to one mother substance, he has succeeded in building them all up from this mother substance—a piece of work which with but one exception, has no equal in synthetic chemistry.

The one exception is Fischer's crowning series of researches on the proteins. No work approaching this had ever been done before.

Fischer was not the first to tackle this problem of problems, but he was the first to give the lead in the right direction.

The crude physical methods of classifying proteins have pointed to the fact that there are some forty to fifty in number. All of these, when hydrolyzed, give a large percentage of the nineteen amino-acids which are common to most proteins; the differences among proteins is most marked in the amount of the various amino-acids which they yield when hydrolyzed.

Due in no small part to the labors of Fischer and his co-workers most of these nineteen amino acids have been synthesized from simpler bodies.

If the hydrolysis of proteins, and the careful investigation of the decomposition products so produced was a difficult task, what are we to say of the reverse process, whereby, by starting with amino-acids, we build up proteins? Yet that is what Fischer did. He succeeded in working out methods by which amino-acids could be chemically joined on to one another in some such way as the links of a chain. He has given the name *polypeptids* to such combinations of amino-acids.

In his most celebrated experiment in the synthesis of proteins, Fischer succeeded in combining eighteen amino-acids—an octadecapeptide—which is the most complicated artificial substance that has ever been produced, and which shows some very striking resemblances to the natural proteins, not the least of which is the way trypsin, the pancreatic enzyme, breaks it up into the amino-acids out of which the artificial protein was built.

The starting materials for this synthesis cost $250, "so that," says Fischer, "it has not yet made its appearance on the dining table!"

These glorious researches were still in full blast in 1902 when Fischer was awarded the Nobel prize in chemistry.

There seems to be some foundation for the fact that the opening up of our Rockefeller Institute in New York City gave German scientists some very unpleasant moments. They were afraid that an institute, devoted entirely to research, and manned by talent second to none, would soon outstrip any university, where of necessity teaching, aside from research, required much attention. This led Ostwald, Nernst and Fischer to start an agitation for the endowment of some similar institute in Germany, with the result that the research institute in Berlin-Dahlem was founded.

Fischer's researches into the carbohydrates, purines and proteins, is of such enormous importance that, at the repeated requests of the scientific public, they were published in book form in three bulky volumes, the first, "*Untersuchungen über Amino-Sauren, Polypeptide und Proteine*" (1899–1906), dealing with the proteins, the second, "*Untersuchungen in der Purin Gruppe*" (1882–1906), with the purines, and the third "*Untersuchungen über Kohlenhydrate und Fermente*" (1884–1908), with the carbohydrates and enzymes. It is certain that in organic chemistry no three volumes of such far-reaching influence have ever before been published.

Fischer's most recent work dealt much with the tannins, substances that play an important part in leather manufacture.

Fischer's work, his influence as teacher and inspirer of men, raised the Berlin Chemical Laboratory to the first position among the chemical laboratories of the world. His fame attracted students from every quarter of the globe, and these flocked in such numbers to him that they soon counted in the hundreds, and special *privat-docenten* had to be appointed to take care of them. It thus came about that many of the men who had gone to Berlin to work under Fischer in reality worked under some of Fischer's *privat-docenten*, and, outside of the lectures, probably did not see Fischer himself more than two or three times during their three or four years in the German capital. At one time or another H. Gideon Wells, that excellent pathologist of Chicago University, T. B. Osborne, of the Connecticut Experiment Station, and the foremost authority on vegetable proteins, and P. A. Levene and W. A. Jacobs, the well-known physiological chemists of the Rockefeller Institute, were his students. Of his many pupils Fischer considered Emil Abderhalden, now the professor of physiology at Halle University, a Swiss by birth, the most gifted.

Fischer's death is an irreparable loss to science. He is so much of our generation that one hesitates to use superlatives, but one is sorely tempted to speak of him as the greatest organic chemist of all times.

BENJAMIN HARROW

COLUMBIA UNIVERSITY

SCIENTIFIC EVENTS

DESTRUCTION OF ELEPHANTS IN CAPE COLONY

A SPECIAL correspondent of the London *Times* writes that the provincial council of the Province of the Cape of Good Hope has passed a decree authorizing the destruction of the herd of elephants in the Addo Bush Forest Reserve. Unless this Union government take action promptly, this hitherto carefully-preserved remnant of a species that once ranged all over South Africa will be utterly destroyed. The last elephant in Zululand, an old male, was recently killed. The elephants of South-

ern Rhodesia have been exterminated. In the Eastern Transvaal, near Portuguese territory, a few survivors of a small troop occasionally are seen, but they are being attacked from both sides and are on the verge of extinction. It is possible that there may be a few individuals left in the Knysna Forest, Cape Colony, but the game warden is extremely doubtful about this.

The Addo Bush, near Port Elizabeth, until recently was a waterless scrub of little value. In its center an area of approximately 6,000 acres has long been a reserve for the elephants. The land is not fenced off, and farms at first of small value, but now being developed by irrigation works from Sunday's River, surround it. The herd numbers between 100 and 200 individuals, the only surviving examples of a distinct variety, characterized by a strongly arched forehead, enormous ears, roughly square outline, short fore-legs and a very hairy body.

The proposed action is not a case of wanton destruction. The Provincial Council has given long consideration to the matter, and has passed the decree only after careful investigation by a special committee, whose members were fully alive to the zoological calamity that their recommendation involved. The elephants sally out of their reserve in quest of food and water. They break down fences, stampede cattle, destroy crops, and frighten human beings. They assume that the irrigation canals are intended for their benefit and in taking their baths they destroy the banks and dams.

The committee reported that the elephants could be confined only by the erection of a fence 13 miles in length, and a structure sufficiently strong to contain elephants would have cost at least £20,000. It would have been necessary, moreover, to provide a water supply, and it is more than doubtful if the area enclosed would have provided natural food in sufficient quantities.

AN AMERICAN HOSPITAL FOR GREAT BRITAIN

THE *British Medical Journal* reports that plans for the establishment of an American hospital in London are now in so advanced a stage that a meeting of the governing council had been arranged at the house of the Royal Society of Medicine, at which Lord Reading (who has accepted the presidency of the hospital) and the American Ambassador promised to be present. Upon the signing of the armistice last November it was considered that the moment was ripe for bringing the project of an American hospital to the consideration of the medical profession in Great Britain as well as of the American colony in London. The promoters were of opinion that the need of the foundation of such a hospital was obvious, and that the exceptional opportunities of the moment were never likely to recur. The scope which should be given to the hospital was discussed by a Medical Executive Committee, consisting of Sir William Osler, Sir Arbuthnot Lane, Sir Humphry Rolleston, Sir John Bland-Sutton, Mr. J. Y. W. MacAlister, and Mr. Philip Franklin. At the meeting of the American Medical Association, in Atlantic City, in June, Sir Arbuthnot Lane notified officially that the hospital would be established. He pointed out that no more fitting monument could be raised to those who had fallen in the war, and that the hospital was designed to form the headquarters for American medical men who visited Europe for the purpose of post-graduate study. At the meeting the plans of the committees, as described by Sir Arbuthnot Lane, were received with enthusiasm, and he was assured by distinguished members of the profession that the medical men of America were keenly alive to the great value of such an institution in England as a center for study and research. A committee was then formed to ensure the cooperation of American doctors upon a definite footing, and to act in conjunction with the executive committee in London, and, if desirable, to work under the National Research Council at Washington. This American committee consists of Dr. George W. Crile, of Cleveland; Dr. W. J. Mayo and Dr. Charles H. Mayo, of Rochester, Minnesota; Dr. Albert J. Ochsner, of Chicago; Dr. Rudolph Matas, of New Orleans, and Dr.

Franklin Martin, of Chicago. This committee will send a delegate to assist the London Medical Committee here in the detailed organization of the hospital. It has, we are informed, been planned upon the most modern lines, and will be complete in every department of medical and surgical activity; accommodation will be arranged for every class of patient. A research institute, modelled upon the Rockefeller Foundation of New York, will form an integral part of the plan. The consulting staff will bring together distinguished members of the profession in the United States and Great Britain. The visiting staff will be nominated by the executive medical committee. The governing council of the hospital consists of many prominent members of the American colony in London. Mr. Philip Franklin is acting as honorary secretary.

THE COMMITTEE ON FOOD AND NUTRITION OF THE NATIONAL RESEARCH COUNCIL

This committee held an organization meeting at Cornell University Medical College, New York City, on July 11. The following tentative program was presented by Professor Henry P. Armsby and was adopted with but slight modifications:

Regarding the committee as being substantially a coordinating rather than a research body, the following tentative outline of objects and methods is suggested.

OBJECTS

1. To promote scientific research upon the nutrition of men and of animals (especially animals of agricultural importance) and to bring about closer relations between the two fields of work.

2. To promote study of the economic aspects of nutrition—*i. e.*, study of national and international as distinguished from personal nutrition.

4. Pending the possible establishment of a National Institute of Nutrition, to act as an unofficial clearing house for existing research institutions and to promote coordination of both American and foreign research.

4. To promote sane and authoritative extension and propaganda work in the interest of better nutrition.

METHODS

In considering methods, it must be borne in mind that the committee has only moral and not mandatory authority. In all plans, care must be taken to preserve the democracy of science.

1. (*a*) Preparation of a broad program of research in both human and animal nutrition, emphasizing especially gaps in present knowledge with suggestion of problems of more immediate importance.
   (*b*) Maintenance of research fellowships.
   (*c*) Subsidizing of especially important researches.
2. (*a*) The cooperation of statistical agencies would appear necessary.
3. (*a*) Meetings of the committee and of nutrition investigators in general, especially for the sake of maintaining personal touch and considering programs of research.
   (*b*) Correspondence and publications.
   (*c*) Representation of the United States in the International Scientific Commission of Nutrition.
4. (*a*) Cooperation with existing governmental agencies and educational institutions, especially of the land grant colleges.
   (*b*) Cooperation with the American Public Health Association.

Among the questions affecting public welfare which require immediate investigation, the committee considered the following the most important:

(*a*) Practical changes in methods of food production for the purpose of reducing the cost of living without reducing the quality of nutrition.

(*b*) Diet in relation to industrial efficiency.

(*c*) The food requirements of growing children.

It was estimated that thirteen fellows of the National Research Council could profitably be put to work at once upon these problems and various possible sources of funds were discussed.

Miss Isabel Bevier was elected an additional member of the subcommittee on human nutrition and Dr. W. H. Jordan and President Raymond A. Pearson were elected additional members of the sub-committee on animal nutrition.

Information has been received from Dr. Alonzo E. Taylor, who is still in Paris, that "The Inter-Allied Scientific Food Commission closed its existence at Brussels on May 25 with recommendations to the governments

involved to form an Institute for the Study of Nutrition, to be connected with and a part of the League of Nations in precisely the same manner as the League of the Red Cross will stand with reference to sanitation."

SCIENTIFIC NOTES AND NEWS

DR. ERNST HEINRICH HAECKEL, professor of zoology at the University of Jena since 1865, died on August 9 at the age of eighty-five years.

AT a meeting of the Royal Society of London, held on June 26, Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, was elected a fellow.

THE former students of Dr. T. C. Chamberlin, for twenty-seven years head of the department of geology at the University of Chicago, are planning to hold a dinner in his honor on the evening of September 27 in Chicago. Dr. Chamberlin has recently retired with the title of professor emeritus and expects to celebrate his seventy-sixth birthday in September. Further information concerning the dinner may be obtained from Kirtley F. Mather, Granville, Ohio.

OUR attention has been called to the fact that prior to the election of Dr. George E. Hale to be a foreign associate of the Paris Academy of Sciences the distinction had been conferred on five other Americans: Benjamin Franklin (1772), Count Rumford (1803), Louis Agassiz (1872), Simon Newcomb (1895), and Alexander Agassiz (1904).

IN recognition of his fifty years' service as a teacher of physical education, Dr. Dudley A. Sargent, retiring director of the Hemenway Gymnasium, was presented on August 7 with a large loving cup and punch bowl. The gift comes from students in the department of physical education of the Harvard Summer School.

THE Franklin Institute, Philadelphia, acting through its Committee on Science and the Arts, has awarded to Joshua J. Skinner, of the Bureau of Plant Industry of the Department of Agriculture, its Edward Longstreth Medal of Merit for a paper on "Soil Aldehydes," appearing in the five issues of the *Journal* of The Franklin Institute from August to December, 1918. In awarding this medal, the committee reported:

> These papers present the results of scientific study of a new class of deleterious soil constituents, clearly described and effectively illustrated, the whole forming a valuable contribution to the science of agricultural chemistry, and one of marked practical importance.

In 1912 this medal was awarded to Dr. Oswald Schreiner and Dr. E. C. Lathrop, also of the Bureau of Animal Industry.

DR. ASA C. CHANDLER, assistant professor of zoology and physiology at the Oregon Agricultural College, who made a study in the trenches at the European war front of rats and parasites in their relation to transmitting diseases to human beings, is now in California and will return to the college next school year.

DR. D. G. BYERS, of the University of Washington, has been appointed chief of the division of chemistry in the Bureau of Soils, U. S. Department of Agriculture. Mr. W. O. Robinson, of the Chemical Warfare Service, has returned to the bureau.

MR. W. E. PERDEW recently resigned his position as chemical engineer in the Petroleum Division of the Bureau of Mines to enter the employ of the Union Petroleum Company of Philadelphia.

PROFESSOR WILLIAM PETERSON, geologist for the Utah Agricultural Experiment Station and College, has been granted a six-months' leave of absence to make an appraisal of the mining properties of Utah for the State Board of Equalization.

PROFESSOR W. M. COBLEIGH, professor of chemistry in the State College of Agriculture and Mechanical Arts, of the University of Montana, has been appointed state chemist under provisions made in an oil inspection law passed by the Montana legislature. The work of the state chemist will be organized as a part of the required work of the department of chemistry.

PAUL ASHLEY WEST, formerly instructor of chemistry, The Jessup Scott High School, has

accepted the directorship of The Research Laboratories Company of Toledo, and Dr. G. A. Kirchmaier, for twenty-two years city chemist of the city of Toledo and for the State Agricultural Department, has accepted the position of consulting and analytical chemist with this company.

DR. NORMAN A. SHEPARD, assistant professor of chemistry at Yale University, has resigned to accept the position of research chemist with the Firestone Tire and Rubber Co., Akron, Ohio.

THE *Journal of Industrial and Engineering Chemistry* reports that a "Fixed Nitrogen Research Laboratory" has been organized in the nitrate division of the Ordnance Department, with headquarters at the American University, in buildings formerly occupied by the Chemical Warfare Service. Lieutenant Colonel A. B. Lamb, of the Chemical Warfare Service, is director; Dr. R. C. Colman, formerly of the Chemical Warfare Service, and Professor W. C. Bray, of the University of California, are associate directors; and Dr. H. A. Curtis, formerly of the nitrate division, Ordnance Department, is executive officer. The work carried on during the war on the fixation of nitrogen in the Department of Agriculture laboratories at Arlington, Virginia, the geophysical laboratory, and elsewhere, will be concentrated at the American University. In the absence of Colonel Lamb in Europe, Dr. Tolman is acting director. At present the staff consists of fifty-five persons.

DR. W. J. V. OSTERHOUT, professor of botany in Harvard University, will deliver a series of six lectures on the Hitchcock Foundation of the University of California from August 20 to 29 on the general topic, "Fundamental life processes." Dr. Osterhout was assistant professor of botany at the University of California from 1907 to 1909.

A FRENCH edition of Professor Vernon Kellogg's "Headquarters Nights," with a special preface by Minister Brand Whitlock, has just been issued by the Paris publishing house of Payot et Cie.

Nature states that Dr. H. R. Mill has retired from the position of director of the British Rainfall Organization and from the editorship of *British Rainfall* and *Symon's Meteorological Magazine*, which he has carried on since 1901. Serious impairment of eyesight consequent on overwork led Dr. Mill to make arrangements for retiring in 1914, when the outbreak of the war caused him to postpone the step; he now finds his health unequal to the strain of adapting the work to post-war conditions.

THE *Journal* of the American Medical Association reports that having reached the age limit of seventy-five, Camillo Golgi retires from the chair of general pathology and histology at the University of Pavia, but still retains charge of the institute connected therewith where he has been uninterruptedly at work for almost fifty years. A scholarship has been founded in his honor by his friends and pupils, the scholarship to be given to the orphan of some physician killed during the war. At an imposing ceremony he was presented with a gold medal and souvenir album signed by the citizens of Pavia, with other honors. His discovery of the stain which first revealed the finer structure of the nervous system was made during his service in a small hospital at Abbiategrasso, remote from the centers of learning. The Nobel prize in medicine in 1906 was divided between Golgi and Ramõn y Cajal.

ACCORDING to a statement recently issued by the Surgeon General of the United States Army, 442 casualties occurred among the medical officers of the American Expeditionary Forces in France from July 1, 1917, to March 13, 1919. Of these 22 died of wounds, 9 of accidents, 101 of disease; 46 were killed and 7 were missing in action; 4 were lost at sea. There were 38 prisoners unwounded, 47 wounded in action (degree undetermined), 93 severely wounded in action, and 72 slightly wounded.

THE summer meetings of the American Astronomical Society, American Mathematical Society, and Mathematical Association of America will be held at Ann Arbor, Mich., during the week September 2–6. A joint session of the three organizations is arranged

for the afternoon of September 4, at which the program will include the retiring address of President E. V. Huntington, of the Mathematical Association, report on the international conference of scientists at Brussels, and report by Professor E. W. Brown, of Yale University, on the work of the National Research Council with reference to mathematics and astronomy. Special railroad rates may be available for this meeting if the attendance is sufficiently large.

THE eighth meeting of the technical personnel of the experiment stations, and of the officers of the Department of Agriculture, of the Dutch East Indies, was held in Medan, Deli, Sumatra, April 23–29, 1919. On the first day a session was held at the Deli Proefstation voor Tabak; papers on botany, geology and chemistry were read by E. C. J. Mohr, J. G. J. A. Mass, F. C. van Heurn, A. A. L. Rutgers, S. Tijmstra, and P. E. Keuchenuis. From April 24 to April 28, an excursion was made over the east coast of Sumatra, visiting oil-palm, rubber, tea, coffee and tobacco estates. A trip was also made over the beautiful Toba Lake and the Karo Plateau. The largest rubber estate in the world was among those visited. This is owned by the Hollandsche-Amerikaansche Plantage Maatschappij, a subsidiary of the United States Rubber Co. Here a banquet was given in honor of the visiting scientists. After the return to Medan, another session was held at the Deli Proef-station, at which papers were read by Carl D. La Rue, and Ir. Kalshoven. At the same session an organization was made under the name of "Vereeniging van Proef-station Personneel." The society is intended to bring about closer cooperation between the various public and private experiment stations, and to promote the interests of science and scientific men in the Dutch East Indies.

Nature states that the council of the British Association recently instructed a deputation, consisting of Professor Arthur Keith, Sir Edward Brabrook and Professor A. W. Kirkaldy, to wait upon the Ministry of Pensions in order to urge the utilization of anthropometric and kindred data collected by the disbanded Ministry of National Service. The deputation was received on behalf of the Minister of Pensions by Colonel Arthur L. A. Webb, director-general of Medical Services, Ministry of Pensions, who explained that the medical statistical department of the Ministry of National Service, of which Dr. H. W. Kaye was in charge, and the data collected by that department, had been taken over by the Ministry of Pensions Dr. Kaye had not only to direct the compilation of medical recruiting statistics, but also to organize a special branch to deal with medical data connected with the Ministry of Pensions. It was thus impossible for Dr. Kaye's department to give its undivided attention to the preparation of returns relating to the physique of recruits in the various areas and trades of the country. At the present time all the data relating to Grade IV. men were being examined and compiled. Colonel Webb also explained that Dr. Kaye's department was endeavoring to obtain data for comparison from Canada, New Zealand and the United States. The deputation, before withdrawing, thanked Colonel Webb, and urged the early publication of results, which are now needed by all who are studying problems connected with the present physical condition of the population.

THE *Journal* of the American Medical Association quoting from the report of the New York Milk Commission on the infant mortality rates of the different cities of the United States for the year 1918, states that the infant death rate for New York City was 92 per thousand living births. Although the estimates show that the death rate for the country increased seven points last year, the milk commission believes these rates are remarkably low when all the elements conspiring against the baby are considered. The infant mortality rate of seventy-nine cities with populations under 50,000 was 97.2. The rate for thirty-eight cities of between 50,000 and 100,000 was 113.8, and that for forty-five cities of 100,000 population was 103.5 The average baby death rate for the registration area of the United States is 104. Twenty-two of the cities of 100,000 are above this average, and twenty-

two are below. The rates for a number of the larger cities are reported as follows: Chicago, 104.8; Philadelphia, 126; Boston, 114.9; Baltimore, 147.8; Pittsburgh, 122.5; Buffalo, 121.5; Milwaukee, 108.2; Cincinnati, 104.1; Newark, N. J., 104.7; New Orleans, 123.3; Washington, D. C., 110.9; Jersey City, 118.7; Louisville, Ky., 117.3; Denver, 107.3; Syracuse, N. Y., 117.4; Birmingham, Ala., 133.5; Memphis, Tenn., 145; Scranton, Pa., 144.3; Richmond, Va., 146.3; Fall River, Mass., 161.3; Lowell, Mass., 159.1; Albany, New York, 107.4. Only three cities reported baby death rates below 50. These cities are all of the class below 50,000. Brookline, Mass., has the lowest rate, 35.4; Madison, Wis., is next with 38.1, and Pasadena, Calif., third, with 43.8.

As a result of meetings between the government and representatives of technical and scientific societies, a department of glass technology was opened at Sheffield University. From very small beginnings the department has grown quickly and to-day it is turning out work equal to anything the Germans have done. As most of the work has been of an experimental nature the cost has been heavy. Much has yet to be done, with this object in view, if the industry is to be commercially sound and able to compete in the world's markets. A Glass Research Association is being formed. The government being asked to provide £75,000 over a period of five years and the manufacturers are expected to contribute another £25,000. The Controller of the Glass Ware Department of the Ministry of Munitions has called a meeting of manufacturers to discuss the scheme. Substantial promises have already been received from manufacturers interested and a provisional committee has been appointed. The Association will first turn its attention to problems of machinery and labor-saving devices.

THE *American Museum Journal* states that about twenty miles south of the great fossil quarry at Agate, Nebraska, there is a peculiar fossil deposit of somewhat later geological age, which has been called the Snake Creek beds. They consist of a series of small pockets in the sand and gravel beds near the surface, full of fossil teeth and bones, mostly fragments, but with many jaws and complete bones and occasional skulls among them. Three-toed horses are the most numerous; many thousands of teeth have been found, hundreds of jaws, and one fairly complete skeleton. A great number of other animals of the Lower Pliocene are represented in the American Museum collections from the pockets, obtained in 1908 and 1916. During this last summer Mr. Albert Thomson has obtained for the Museum an additional collection which includes a few specimens, the best being fine skulls of the long-legged rhinoceros, *Aphelops*, and the rare rodent, *Mylagaulus*. The collection which he has brought back to the museum will add materially to our knowledge of the mammalian life of the Lower Pliocene.

WE learn from the *Journal* of the American Medical Association that four measures appropriating funds and authorizing the United State Public Health Service to investigate and combat a recurrence of the influenza epidemic are now before Congress. Senator Warren G. Harding, of Ohio, has introduced a joint resolution appropriating $5,000,000 for an investigation of influenza and pneumonia. His measure cites that the recent influenza epidemic caused 500,000 deaths in the United States. The Public Health Service and research institutions are authorized to make this investigation. A bill introduced in the House by Congressman Simeon D. Fess, of Ohio, authorizes the Public Health Service and the medical departments of both the Army and the Navy to investigate and combat the disease and appropriates $1,500,000 for this purpose. Congressman William W. Larsen, of Georgia, and Congressman Black, of Texas, have introduced similar bills for making an investigation of influenza and allied subjects. The Larsen and Black measures carry an appropriation of $500,000 each. All four measures charge the United States Public Health Service with carrying out the provisions of the act, although cooperation with the army and navy medical departments is advised.

WE learn from the *Journal* of the American Mathematical Society that the technical staff of the United States Ordnance Department has been authorized to secure the services of five experts in mathematics and dynamics, at salaries ranging from $2,500 to $5,000, to conduct scientific research on ordnance problems, act as advisers on all mathematical and scientific problems, for the ordnance department, and keep up connections between the department and the scientific world.

UNIVERSITY AND EDUCATIONAL NEWS

GEORGE EASTMAN, head of the Eastman Kodak Company, has given the sum of $3,500,000 for the establishment of a school of music in connection with the University of Rochester. The school will aim to aid the development of an appreciation of the highest type of motion pictures as an ally of the highest type of music.

IT is stated in *Nature* that to a private deputation from the Education Committee of the Parliamentary Labor party, which urged upon him the desirability of an inquiry into the organization and financial position of the universities of Oxford and Cambridge, Mr. Fisher has made the announcement that the government has decided to appoint commissions to inquire into the position of the universities of Oxford and Cambridge. At both universities the existing resources have proved inadequate to meet the increased cost of maintenance of the various departments, and a few months ago the authorities of each independently applied to the government for financial aid. In reply to these requests Mr. Fisher, on behalf of the government, stated that such grants out of Parliamentary funds could be sanctioned only on the condition that in due course comprehensive inquiries into the whole resources of the universities and their colleges and the use made of them should be instituted by the government. The Cambridge senate on May 31 authorized the vice-chancellor to inform Mr. Fisher that the university would welcome a comprehensive inquiry into its financial resources, and at Oxford a similar decision was taken by convocation on June 10.

DR. ERNEST SACHS, hitherto associate professor of surgery in the medical school of Washington University, St. Louis, has been appointed professor of clinical neurological surgery in the same institution. This is the first instance in which any medical school has recognized neurological surgery by creating for it a separate department.

DR. L. J. GILLESPIE, of the Bureau of Plant Industry, has been appointed professor of physical chemistry in Syracuse University.

DR. N. A. LANGE, formerly instructor in organic chemistry at the University of Michigan has been appointed assistant professor of organic chemistry at the Case School of Applied Science, Cleveland.

DR. HARRY D. KITSON, instructor in psychology at the University of Chicago, has accepted the position at Indiana University made vacant by Professor E. C. Lindley, who accepted the presidency of the University of Idaho.

DR. CLIFFORD H. FARR has resigned his position in the Bureau of Plant Industry to accept appointment as assistant professor of plant physiology in the University of Iowa.

AT the University of Georgia, Paul Weatherwax, Ph.D. (Indiana), has been appointed associate professor of botany with special reference to physiology and genetics. Joseph Krafka, Jr., Ph.D. (Illinois), has been appointed associate professor of zoology, and John Moore Reade, Ph.D., professor of botany, has been made director of the biological laboratories.

APPOINTMENTS for next year at the college of arts and sciences, University of Buffalo, include the following: Daniel B. Leary, formerly head of department of education at Tulane University, to be professor of psychology and instructor in Russian; Edward J. Moore, associate professor of physics at Oberlin College, to be professor of physics, and Albert R. Shadle, assistant professor of zoology at Cornell, to be assistant professor of biology.

PROFESSOR A. FINDLAY, professor of chemistry, University College of Wales, Aberystwyth,

has been appointed to the chair of chemistry in the University of Aberdeen in succession to Professor Frederick Soddy.

SIR J. J. THOMSON, master of Trinity College, Cambridge, who recently resigned the Cavendish professorship of experimental physics, has been elected into the newly established professorship of physics. This professorship is without stipend, and will terminate with the tenure of office of the first professor unless the university determines otherwise.

DISCUSSION AND CORRESPONDENCE

FIRE-WALKING IN JAPAN

DURING my four years' residence in Japan I had several opportunities of witnessing the spectacular religious or quasi-religious ceremony periodically observed at the Ontake Temple, Tokyo, in the course of which the officiating priests walk barefoot over a bed of live charcoal, throw boiling water over themselves and climb a ladder of sharp swords set edge upward. All these pretended miracles, however, are susceptible of scientific explanation, and it is only with regard to the first-mentioned—the fire-walking—that I venture to ask the privilege of making a brief statement in SCIENCE.

To the great mass of the spectators in the temple enclosure, who do not usually include more than the merest sprinkling of the more intelligent and better educated classes of the Japanese people, the supposed miracles are the clearest demonstration of the supernatural power of the priests, who would have it believed that it is solely to their incantations that they owe their protection from injury. But it is not necessary to be a very close observer of their movements to perceive that the priests are not content with their perambulations, genuflexions and prayers, but are careful to rub their bare feet with salt, *ostensibly for purificatory purposes*, before walking over the fire. This fact brought to my recollection the occasion, forty years ago or more, when Tyndall astonished a distinguished audience at the Royal Institution by plunging his bare arm into molten metal, the then Prince of Wales, afterward King Edward VII., who was present, being prevented from following Tyndall's example only by the determined opposition of his wife.

So sure did I feel of the efficacy of the salt as a protective agent that on my second visit to the temple I determined to follow the priests in their apparently hazardous adventure, and so after rubbing my feet well in the pile of salt, I walked rapidly over the bed of glowing coal, some eighteen feet long. My confidence was not misplaced. In my feet I felt only a sensation of gentle warmth, but my ankles, to which no salt was applied, were scorched.

After a careful examination of such of Tyndall's works as I had access to at the Yokohama Club, without finding any reference to the demonstration at the Royal Institution, I wrote to Sir William Crookes, who not long before had mentioned to me his association with Tyndall in some of the experiments that preceded the delivery of the latter's famous "Lectures on Light." In due course I received Sir William's reply, in which after reference to certain matters of no special interest in this connection, he said:

> I do not know of any published account of Tyndall's putting his bare arm into molten metal, but I can well believe it, as I myself have plunged my hand into molten, almost red-hot, lead. I was in a profuse perspiration at the time, and, immediately before, I dipped my hand into strong ammonia, to increase the spheroidal effect. I do not think the extra precaution was of much use, but I did not like to take a risk when looking at the cauldron of hot metal.

To physicists there is nothing new in all this, but not every scientific man is a physicist, or hypnotism would not have been suggested to me, as it has been, as the secret of the remarkable immunity I experienced.

JOHN HYDE

WASHINGTON, D. C.

MARCHING IN STEP

TO THE EDITOR OF SCIENCE: In regard to Walter Moore Coleman's note in the April 18 number of SCIENCE concerning variations in phase in the step of a column of soldiers it

would seem hardly necessary to attribute the perfect marching in the absence of sound signals to any mutual subconscious force passing betwen the men. Would it not be reasonable to infer that in this case the rhythm is sight-transferred? To be sure, in a long straight column any particular squad would not be able to see far down the line, but in getting the time of the step from those somewhat in advance of them there would seem to be as much likelihood of the slight error having either sign, so that there would be no accumulation in error back through the column, as occurs in the case of establishing the rhythm by means of sound signals at the head of the column. That there is, in the absence of sound signals, a sway and swing absent at other times, may be solely a result of perfect rhythm, rather than a result of any difference in the marching of any one man. It is conceivable that in a column of men every man would be marching with rhythmic step, and with dash and enthusiasm, and yet there would be no satisfactory swing and sway to the column if the men were in slightest amount out of step. Synchronize their movements, and the result becomes immediately rhythmic and inspiring, although each man may be taking the same steps in exactly the same way.

That a marching column accepts audible signals in preference to visual signals in case both exist is, I should suppose, a matter of common knowledge. The writer had occasion to drill on the grass-covered Ellipse at Washington many mornings last summer before the heavy dew had gone. The dominant note caused by marching was not that resulting from the planting of the foot, but rather that from the movement through the heavy wet grass—a sound exactly out of phase with the former which ordinarily, in a small body of men, gives the sound signal for the rhythm. The strenuous West-Pointer who was conducting the drill never seemed to realize why he could not keep the men in step at such times. There was a continual wave of changing of step passing back through the column, in an everlasting but hopeless endeavor to make the step coincide with a signal automatically and inescapably out of phase with it.

Warren Weaver
University of Wisconsin,
Madison, Wis.

SCIENTIFIC BOOKS

The Elementary Nervous System. By G. H. Parker. Philadelphia, J. B. Lippincott Co. 1919. Pp. 227, figs. 53.

With characteristic lucidity, Dr. Parker has written the second of the Monographs on Experimental Biology of which Dr. Loeb's "Forced Movements, Tropisms and Animal Conduct" is the first. Limited by the plans already outlined for subsequent volumes of the series to subject matter "drawn almost entirely from the three simpler phyla of the multicellular animals, the sponges, cœlenterates and the ctenophores," this book is nevertheless an illuminating introduction to the more fundamental problems of nervous systems in general. Anatomy and histology are not neglected. The author, however, has attacked the subject frankly as a physiologist, by the method of quantitative experimental analysis that in recent years has been revealing a more and more intimate kinship between biology and the maturer sciences of physics and chemistry. The bibliography at the end of the volume contains one hundred and sixty-six titles, and the author has been exceptionally careful, by frequent references throughout the text, to acknowledge his appreciation of the work of others. Yet, owing to the comprehensiveness of his own researches, he has been able in the development of his theme to review many of his own experiments. In this way, though these reviews are necessarily brief and untechnical, he makes of the reader a co-investigator who shares with him his own keen interest in the problem, his rare skill in devising experiments that are masterfully direct and simple, and who feels the confidence in the results that clear-cut workmanship inevitably inspires.

In an introductory chapter the neuromuscular mechanisms of the higher animals are analyzed into receptors (sense organs), ad-

justors (central nervous organs) and effectors (muscles or other organs that enable the animal to react on the environment). Of these, effectors alone are found in sponges. "They mark the beginnings of the neuromuscular mechanism in that they possess the original and most ancient of its constituents, muscle, around which the remainder of the system is supposed subsequently to have been evolved."

Two chapters are devoted to the sponges, a third to independent effectors in the higher animals, and a fourth to a sluggish type of non-nervous transmission (*neuroid*) that is exhibited by sponges, ctenophores and probably by the ordinary tissues of animals. These four chapters constitute the first of three sections concerned respectively with effector systems, receptor-effector systems, and central nervous organs.

Section two, comprising eight chapters, deals with the neuro-muscular structure of, and nervous transmission in, sea anemones, jellyfishes and hydroids; the nerve net, of which their nervous systems are in large part representative, and which reappears also in the higher animals, *e. g.*, in connection with the musculature of blood vessels and intestine; the diffuse transmission which characterizes the nerve net; and its relation to the appropriation of food and other complex responses.

The single chapter in section three discusses by way of conclusion the relations of the elementary nervous system to the central nervous system of the more complex animals, especially the evolution of that novel element in the system, the central organ or adjustor, which arises in the region between receptor and effector and out of that material which in the elementary system constitutes the nerve net.

General readers as well as special students of science may congratulate themselves on the publication of another book in the growing list by American authors that is making accessible to them in untechnical and attractive form the latest episodes in scientific progress, each with all the authority of a master in his chosen field.

Harry Beal Torrey

NOTES ON METEOROLOGY AND CLIMATOLOGY

METEOROLOGY AS A SUBJECT FOR STUDY

The great importance of weather in military operations[2] early made current European weather information a matter of military secrecy, and put a premium on meteorologists. The U. S. Signal Corps met the demand by training about 500 scientific and technical men in meteorology,[3] and the Naval Aviation Service trained about another 100.[4] Meteorology was also introduced in some institutions as part of the prescribed work of the S.A.T.C.,[5] but most of them had planned this work for the second or third term, and so failed to give it.

Thus at the end of the war, in spite of the stimulation, the amount of meteorological instruction given in the United States had changed but little from its pre-war status: in fact, the loss of instructors eliminated meteorology from the list of courses given at a number of institutions. A recent survey of the extent of instruction in meteorology in the colleges and universities of the United States, revealed only 70 (less than a sixth of the number reporting) in which any course in meteorology or climatology were given; though perhaps an additional third of the institutions of higher learning in the country touch on meteorology in more general courses.[6]

Nevertheless, the present demand for meteorological information, particularly for special aeronautical forecasts, is much greater than ever before; and the demand for more detailed forecasts and for longer range ones has become more insistent. Our institutions of higher learning are already beginning to appreciate

[2] See R. DeC. Ward's articles on the influence of weather on military operations: Bibliography in *Monthly Weather Review*, February, 1919, Vol. 47, pp. 84–85.

[3] See *Monthly Weather Review*, December, 1918, Vol. 46, pp. 560–562, and April, 1919, Vol. 47, pp. 210–225.

[4] *Ibid.*, April, 1919, Vol. 47, pp. 225–230.

[5] See the text-book written for this: "Introductory Meteorology," New Haven, 1918, 149 pp.

[6] For further details see *Monthly Weather Review*, March, 1919, Vol. 47, pp. 169–170.

the situation, and a number are planning new or extended courses. In aid of this encouraging tendency and to meet the demands for such information, the Weather Bureau has published a group of articles on "Meteorology as a subject for study." The titles and brief discussions of the contents of these articles follow:

In discussing, "How meteorological instruction may be furthered," Professor R. DeC. Ward of Harvard shows that the pressure of the students' desire for increased facilities for instruction in meteorology, and the enthusiasm of the instructor will probably be most effective in promoting meteorological training at each institution. The second paper is a rather detailed discussion of, "Collegiate instruction in meteorology," by C. F. Brooks, treating particularly of the methods used in the large classes at the Signal Corps school of meteorology at College Station, Texas. In the third article, Dr. O. L. Fassig has discussed the purpose, organization and results of this school. Following this, a group of the most important new meteorological books have been reviewed to aid the student or teacher in selecting such general publications as will be of most immediate use. Professor W. J. Humphreys' "Some recent contributions to the physics of the air," is an abbreviated edition of his vice-presidential address at the Baltimore meeting of the A.A.A.S.[7] It is introduced with the other papers here to indicate to some extent the present-day trend of meteorology.[8] Finally, to direct research to some of the most important problems now confronting meteorologists, a list of fifty subjects for research in meteorology have been compiled by the scientific staff of the central office of the Weather Bureau.

This group of papers, which was published in the December, 1918, *Monthly Weather Review* has been reprinted, and copies have been sent to several hundred colleges and universities. A limited number of other copies may be obtained on application to the chief of the Weather Bureau.

[7] Published in full in Science, February 14 and 21, 1919, pp. 155–163, 182–188.

[8] Annual reviews of the progress of meteorology and climatology in the United States are published in the "American Year Book."

THE MILD WINTER OF 1918–1919

In the eastern United States, and over most of the Missouri Valley the past winter was so extraordinarily open in contrast to the winter of 1917–1918, that a Detroit newspaper was led to say we had both winters together in that cold one. Except in the south, the mean temperatures of last December and January were generally 15°F. higher than during the same period a year before. The snowfall was practically negligible as compared with the great accumulations of the previous "old-fashioned" winter. The accompanying table shows some of the marked contrasts in the weather at representative cities. Perhaps the most extreme reversal is shown by Cincinnati weather. There the mean temperature of December and January, 1917–1918, was 19.3° F., while that for December and January, 1918–1919, was 38.5° F., 19.2° F. higher. The snowfall in the two cold months was 36.5 in., but in December and January, last winter, only 1.2 in. Considering together the daily temperatures and snow on the ground, it seems evident that the heavy snow-cover of the cold months made them still colder than they otherwise would have been.[9]

The warm weather and lack of snowfall was a great economic advantage to the country, for transportation was practically unhindered: in striking contrast to the conditions a year earlier. The snowfall in New York City, 0.4 inch in December, 0.3 in January and 0.7 in February was so slight as not to require any expenditure for snow-removal—truly an extraordinary occurrence.[10]

[9] For detailed discussions of the meteorological conditions of the cold winter, see *The Geographical Review*, May, 1918, Vol. 5, pp. 405–414; Science, 1918, Vol. 47, pp. 565–566, and particularly the article by P. C. Day, on "The Cold Winter of 1917–18," in the *Monthly Weather Review*, December, 1918, Vol. 46, pp. 570–580, 4 figs., 24 charts.

[10] See article in *New York Times*, April 6, 1919, pt. 2, p. 2.

WINTERS OF 1917–1918 AND 1918–1919 COMPARED

	December						January						February					
	Mean Temp. °F.		Departure from Normal		Snowfall (Inches)		Mean Temp. °F.		Departure from Normal		Snowfall (Inches)		Mean Temp. °F.		Departure from Normal		Snowfall (Inches)	
	1917	1918	1917	1918	1917	1918	1918	1919	1918	1919	1918	1919	1918	1919	1918	1919	1918	1919
Boston	23.7	34.7	− 7.9	+3.1	7.0	8.4	21.0	33.2	− 6.0	+ 6.2	13.8	4.1	26.9	32.6	−1.1	+4.6	5.7	6.2
New York	25.0	39.0	− 9.4	+4.6	11.7	0.4	21.6	35.2	− 8.6	+ 5.0	13.6	0.3	29.6	34.7	−1.1	+4.0	3.5	0.7
Washington	27.9	41.6	− 8.2	+5.5	6.8	T.	23.7	38.1	− 9.2	+ 5.2	22.6	0.5	36.8	37.2	+2.3	+2.7	1.5	2.8
Atlanta	36.2	48.2	− 8.4	+3.6	4.9	T.	34.8	43.8	− 7.4	+ 1.6	2.9	0.3	50.8	44.4	+5.6	−0.8	0.0	0.1
Cincinnati	22.3	41.8	−12.1	+7.4	16.3	1.0	16.3	35.2	−14.0	+ 4.9	20.2	0.2	34.5	34.4	+2.1	+2.0	T.	0.4
Chicago	22.4	37.7	− 6.9	+8.4	9.0	8.6	13.3	31.0	−10.4	+ 7.3	42.5	2.0	27.2	30.5	+1.8	+5.1	8.4	6.6
St. Paul	10.1	28.7	− 9.2	+9.4	7.1	6.7	3.7	21.8	− 7.9	+10.2	8.1	6.2	17.4	17.0	+2.4	+2.0	5.0	14.8
St. Louis	26.8	43.0	− 8.7	+7.5	7.5	0.5	18.8	37.8	−12.2	+ 6.8	11.7	0.7	35.6	36.7	+2.1	+3.2	0.2	3.1
Kansas City	23.4	39.4	− 8.1	+7.9	5.3	16.4	17.4	34.4	− 8.8	+ 8.2	10.3	1.0	34.0	34.2	+4.1	+4.3	0.1	13.1
Helena	24.2	28.5	− 0.6	+3.7	31.2	0.6	21.0	32.4	+ 1.0	+12.4	13.4	1.4	23.7	20.4	+1.5	−1.8	5.2	12.5
Boise	43.2	29.6	+11.0	−2.6	T.	2.2	34.4	32.8	+ 5.1	+ 3.5	4.9	0.4	36.0	35.8	+2.2	+2.0	3.2	6.3
Santa Fe	38.2	27.0	+ 7.9	−3.3	0.7	14.4	26.2	24.4	− 2.3	− 4.1	22.7	1.7	35.8	27.2	+3.8	−4.8	1.7	7.6

The region west of the Rockies, which was so warm in the winter of 1917–1918, was generally unusually cold in December, 1918, and in much of Utah, northern Arizona and New Mexico, where the depth of snow was great, in January, and much of February, 1919, as well. Throughout the rest of the region, the past winter was not very unusual.

CHARLES F. BROOKS

WASHINGTON, D. C.

SPECIAL ARTICLES

A POSSIBLE CASE OF INSTINCTIVE BEHAVIOR IN THE WHITE RAT

YERKES and Bloomfield[1] demonstrated that kittens instinctively kill mice but barely implied the instinctive behavior of the mice used. Berry[2] states that mice do not show any fear of cats. The following single observation seems to suggest that white rats do instinctively fear cats. An entirely accidental circumstance furnished a situation in which a young cat came into the presence of several cages of white rats. Although the cages were some feet above the cat, its behavior was quite comparable to that described by Yerkes and Bloomfield. In spite of the intensity of the olfactory stimulus in the room, the reaction of the cat did not take place until the visual stimulus was presented.[3] A periodic and almost spasmodic humping of the back and bristling hair, but entire lack of vocal sounds, were the prominent features. Several minutes produced no change in the situation save that the cat, although making no effort at all to reach the cages, became a little restless. When, however, the cat was placed upon a cage containing five white rats (female) about six months old, their behavior was very definite and specific. The cat responded to the new situation—being high in the air with unsafe footing—by paying no attention to the rats but rather evidencing some fear. The rats retreated to the rear of the cage uttering peculiar whines, and showing other evidences of fear. The cat was then removed and an effort made to feed the rats. A specific vocal sound made by the experimenter has always been sufficient to call the rats to the front of the cage where they are given small bits of cheese. This stimulus has been so grafted on to the feeding reactions that it invariably awakens the rats immediately from sleep, or calls the female from a litter, and, subsequent to the incident described, has repeatedly become prepotent over states of fear produced in other ways. Although over thirty-six hours

[1] "Do Kittens Instinctively Kill Mice?" *Psychol. Bull.*, 1910, 7, pp. 253–263.

[2] Berry, C. S., "An Experimental Study of Imitation in Cats," *J. of Comp. Neurol. and Psychol.*, 1908, 18, pp. 1–25. (Quoted by Yerkes and Bloomfield.)

[3] See Yerkes, *et al.*, *op. cit.*, p. 262.

had elapsed since the last feeding time, it was only by continuous and patient effort that the rats were induced to come forward and take bits of cheese offered. Instead of jumping to some corner to enjoy the morsel undisturbed, however, they huddled together in one place, intermittently whining. An hour later they had eaten their cheese but had not moved from the corner and one was still whining.

A simple test was made in the following manner. The cat was handled and petted a few moments and then an attempt was made to secure a male rat from a near-by cage. The rats are handled so frequently that they ordinarily climb over the hand and lightly bite here and there in search of food. On this occasion, however, the behavior was exactly comparable to that found with the females. In the first case the response might have been to the situation—unfamiliar olfactory and auditory stimuli; and in the second to the situation—unfamiliar odor.

The rats here observed represent ten generations of inbreeding. The writer is positive that during the time he has worked with them no cat has been in the room or near the room. Some such odors may have been carried in the clothing of experimenters, however, but this on close examination seems unlikely. At no time or under any other circumstances has he observed such a specific and definite reaction to a situation as here illustrated. A few hours later the behavior of all the rats was experimentally normal in every way. This observation has suggested the desirability of pursuing a definite experimental method in the problem. An effort will be made to control all the variable factors attending a chance observation and to make some definite statement as to the specific original behavior in this particular situation. It may be that a similar reaction can be evoked by a distinctively strange stimulus. That is, the behavior here illustrated may not be specifically related to the situation —certain unfamiliar qualities of olfactory and auditory stimuli. Any other new stimulus may arouse such reactions, the necessary component of the total perception being just the unfamiliarity or strangenéss and not the specific feline odor. It will be quite possible to take a litter of young and provide appropriate stimuli, the responses to which can be scrupulously noted. Variations in age and sex, variations in the situations provided, variations in feeding periods, etc., and a comparative study of the behavior of the wild Norway rat under similar conditions, should throw some light on this particular form of original behavior.

Coleman R. Griffith

University of Illinois

THE AGRICULTURAL LIBRARIES SECTION OF THE AMERICAN LIBRARY ASSOCIATION

A meeting of the Agricultural Libraries Section of the American Library Association was held at Asbury Park, N. J., June 26, 1919. About forty persons were present, including representatives from the Agricultural College libraries of Indiana, Iowa, Kansas, Massachusetts, Missouri, Montana, New Jersey, North Dakota, Vermont and West Virginia and thirteen from the U. S. Department of Agriculture.

Miss Dixon sketched the accomplishments of the Agricultural Libraries Section since its first meeting at Mackinac in 1910, among the most notable which was the bringing about of the publication of the Agricultural Index by the H. W. Wilson Company.

Mr. Milton J. Ferguson, librarian of the California State Library, in a paper entitled "Getting Books to the Farmer in California," described the county library system, the latest development in the state system, which includes all library activities, municipal, state and others, and which shows the energy, foresight and cooperative spirit, which the state of California exhibits in so many fields.

The paper by Miss Marjorie F. Warner, bibliographical assistant, Bureau of Plant Industry, U. S. Department of Agriculture, on "Bibliographical Opportunities in Horticulture," discussed the need of research in connection with the history of cultivated plants and of horticulture; giving illustrations from work which has been done, specifying certain undertakings which should appeal to agricultural librarians, and concluding with a plea for more scholarly research in bibliography both as an individual asset and as adding to the reputation of our libraries.

On conclusion of the paper a gentleman proving to be Dr. J. W. Harshberger, of the University of Pennsylvania, introduced himself as a stranger attracted to the meeting by its program. He congratulated Miss Warner on her paper, and supplemented it by a brief acount of interesting discoveries he had recently made by roundabout methods in seeking information requested by Dr. Sargent, of the Arnold Arboretum, in regard to the Pierce brothers and their nurseries near Kennett Square, Pa., and also alluded to similar methods pursued in regard to William Young, Jr., whose rare "Catalogue des arbres, etc., d'Amérique" (Paris, 1783), has recently been reproduced in facsimile by Rhoads. Mr. Ferguson's and Miss Warner's papers will be published in the *Proceedings* of the Conference of the American Library Association and in the *Library Journal*.

Mr. Charles R. Green, librarian, Massachusetts Agricultural College, presented for discussion the subject of "A Union Checklist of Agricultural Periodicals." He dwelt on the desirability of a list which should make more readily available the present periodical resources of the agricultural libraries of the country, encouraging interlibrary loans and lessening the unnecessary purchase of little used material, and suggested the possible scope of the list, warning against yielding to the temptation to plan an over large project which it would not be possible to carry out. Should such a list include only periodicals on agriculture and its practically related subjects, such as horticulture and animal husbandry, or should it include also those on its related sciences, such as bacteriology, chemistry, botany, entomology, etc.? Or would it be best to issue no nationwide check list, but for agricultural librarians to make an effort to have material of interest to them, included in the various regional periodical union check lists which are in preparation or contemplation?

Miss L. K. Wilkins, chief of the Periodical Division, U. S. Department of Agriculture Library, led the discussion by describing the list of agricultural periodicals of the United States and Canada, compiled as a personal undertaking by Mr. S. C. Stuntz, formerly of the Library of Congress, later of the Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry. The list which is very comprehensive and in manuscript form, was purchased by the library of the U. S. Department of Agriculture after Mr. Stuntz's death in 1918. Miss Wilkins suggested that this list be used as a basis for the proposed union check list of agricultural periodicals, omitting the historical notes, and biographical sketches of editors.

Mr. H. O. Severance, librarian of the University of Missouri, said he would like to have the list cover periodicals on all sciences allied to agriculture, but the general opinion seemed to be that it should cover only those on agriculture and the branches of agriculture such as animal husbandry, dairying and horticulture.

Mr. H. W. Wilson, president of the H. W. Wilson Company, described the methods being employed in making up the union check list of periodicals of the central states, and Dr. C. W. Andrews, librarian of the John Crerar Library, stated that they would waive exclusive use of the slugs, and would gladly give those for agricultural periodicals to this section, if an agricultural check list were undertaken.

After further discussion, a motion was made to ascertain whether the section thought it desirable to undertake the preparation of such a list, on the cooperative plan. The motion was carried unanimously. Mr. Severance then moved that the chair appoint a committee of three with power to act, and to decide upon methods of compiling and publishing a union check list to agricultural periodicals in libraries in the United States. It was understood that the committee was to make the final decision as to its scope. The following committee was appointed by the chair: Mr. Charles R. Green, chairman, Mr. H. O. Severance and Miss Lydia K. Wilkins.

The question of a union check list of agricultural periodicals is one of great importance to all scientists interested in agriculture. If there are any who have any suggestions to make on the subject, the committee would gladly receive them.

EUNICE R. OBERLY
Chairman

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THE SCIENTIFIC MOBILIZATION IN ITALY FOR THE WAR

THE various manifestations of the present war have had, for the most part, their foundation in applied science and industry. The best minds turned to study methods of offense and defense, based on the application of pure or applied science, and inventive genius has had and still has a wide field in which to find new arms and new devices and to perfect those now existing.

From the beginning of the war, Italy, no less than her Allies, has mobilized her scientific and industrial forces for the one purpose to which all the activities of the country have had to be devoted, and nothing has been spared to help and perfect the great war-machine which *had to* bring victory.

The work began first individually and as demanded by the necessities of the moment; then, a little at a time, for individual work, for the work of individual scientists as officers on the fighting line or in the rear where their technical skill was required, or in the war industries which had to enlarge all their plants rapidly and modify them according to circumstances, there was substituted a single organization, a state institution. This was founded in order to mobilize properly for war purposes all available Italian scientific forces and all the means at the disposal of the numerous laboratories of the schools and state technical establishments.

This institution, which naturally was situated at the Ministry of Arms and Munitions, had the following duties:

(1) To classify and mobilize the various scientific institutions according to their possible utilization and the means at the disposal of each. (2) To study the problems which were eventually proposed by the military technical offices, distribute them to the laboratories and institutions best adapted to the particular

problem, follow the various experimental phases, especially in the case of inventions worthy of attention. The institution was in this way the connection between the military offices and all those who had improvements to propose on the methods of war then existing or new applications or inventions. When the experiments had advanced to such a point of development as to be utilized, it transmitted the results to the military offices for application. (3) To take charge of the shops already mobilized for war work and to adapt others as the need arose. (4) To take care of the completed inventions and researches and the unsuccessful attempts, of the problems overcome and of those yet to be overcome, seeking to improve what already existed and to create new things without repeating long and fatiguing work. (5) To collaborate closely with the analogous institutions of the allies, by means of specially appointed delegates who had to keep informed of the progress made in the various problems, and follow the scientific movement in the allied countries.

The institution thus conceived was definitely established at the beginning of 1916 under the name of Office of Inventions and Research, acting as a department of the Ministry of Arms and Munitions, and under the direction of Senator V. Volterra, who was the authorized proposer and founder. The Minister of Education then authorized the directors of the universities, the heads of the other institutions of higher instruction, and the directors of the scientific and experimental bureaus to put themselves at the disposal of this office, and to correspond directly with it in order that predetermined objectives might be attained most rapidly. In the same way the mobilization was started of the scientific and technical department of our higher institutions of learning, and their relative personnel, with the exception of clinical and other similar institutions engaged in medical work, and they now work assiduously and efficiently.

Some of the institute directors came to Rome to form part of the central office, to coordinate and select the work according to the special aptitude of the personnel of the various local institutions, and the quality of material there available for the researches.

Along with the studies and researches on problems of various kinds and of immediate necessity, the study of inventions was brought under scientific supervision. We should notice that in large part the cases concern proposals made by persons who know little or nothing about the problem which their invention attempts to solve. For a group of those competent, it is easy to exclude, from the enormous number of inventions presented, those that have no foundation; then they may study those for which there is hope of succeeding. On the other hand, these same persons are in a position to engage themselves, each one in the branch of science in which he is most interested, studying the same problems and directing the line along which the same class of inventions must be worked out. More than that, it has been necessary to conduct systematic researches in order to learn the availability in Italy of the raw mineral products needed for certain war-productions; this problem was immediately attacked by our best mineralogists and geologists.

In this way the office promises also to be an institution of permanent utility when the present conflict has ceased and the work of the civilized world is again directed toward more profitable purposes of peace.

For evident reasons the moment for unveiling the results of the work of the Italian scientists for the war has not yet come. But at least we can give the names of the most efficient cooperators of Senator Volterra. Among them these ought to be remembered: Lori Nasini, Miolati, Piola, Fano, Vacca, Millosevich, Corbino, Occhialini, Trabacchi, Ciamician, Angeli, Martelli, Vinassa, Aloisi, Carrara, Dalla Vedova; of our universities and in the military and naval world, Avallone, Valsecchi, Vitali, Buffa and many others.

Although apparently there is no lack of persons and the already available methods are utilized as largely as possible, they are not sufficient. What must be done in Italy on a much larger scale than has been done heretofore is to bring scientific research into direct

relation with industry. The example given us by the United States, which has produced and knows how to produce on such a vast scale without losing sight of scientific research, must be followed to the farthest possible limit. The great industries of Ansaldo, Pirelli, Fiat, the Galileo factories, the Filotecnica, the Rossi Electrochemical factories, and many others which are based on the studies and researches conducted for years by the Italian scientists and engineers, are now having the opportunity to continue their work with the assistance of research laboratories which will perfect, increase and improve their production along lines peculiar to these establishments. But if it were possible for these laboratories to specialize in some branch of pure science without an immediate application, it would all be for the moral and educational gain of the establishment itself and still more of the country.

By means of the special representatives sent to the allied countries, we have been able to compare, step by step, with those made in our country, the conditions and development in the various Allied countries, the improvements made, and the researches which have increased and bettered the methods of offense and defense. Our cooperation with the United States has been and still is of great interest. Though they are geographically very far from the theater of war and have thus lacked the advantage of knowing at each moment what was needed and which ways were the most useful to follow, still their great richness of means and of materials have made it possible that from them and them alone could come that help which has brought us to victory. And close cooperation in scientific and technical matters is of the same importance as that exclusively military. The researches which we could begin with our better knowledge of the necessities and problems which were constantly arising on earth and on sea and in the air, could immediately be developed here where means and materials are not lacking.

When the great struggle is completely at an end, it will be possible to enumerate for the sake of history and as a help in times of peace, the studies and researches made; then we will see what an amount of work has been accomplished and what part has been taken by Italian scientists and engineers in the field of mathematics, and its application in ballistics, in engineering, in electrotechnics, in the natural sciences, in chemistry, in the navy, in artillery, in aeronautics. Notable results have already been attained in utilizing raw materials, which we could dispose of at home or in our colonies, and certain minerals have been discovered which are used in producing steel.

The progress made by Italy in aeronautics is already known. Especially in the construction of aeroplanes have notable results been obtained recently, by employing a *Sva* engine which has been evolved through the cooperation of theory and practise at the Direzione Tecnica dell' Aviazione at Turin. And that this collaboration was necessary and perfect is demonstrated by the aerodynamic qualities of this engine and its exceptional characteristics of flight—especially the small velocity necessary to support it in the air and its great stability.

In the field of dirigibles and of aerial artillery the Central Aeronautical Institute in Rome, which already long before the war had made and published aerodynamic studies under the direction of Crocco, Ricaldoni, Prassone, Bianchi and many others, was ready to do their share in the present war, in which the operations of our dirigibles have been universally noted. These dirigibles, which are certainly among the most perfect engines of their kind, are the results of long years of theoretical and practical study at the Institute of Rome. The aerial artillery, under Volterra and Crocco, has had a beginning which will make it a powerful weapon as soon as we can use it on a large scale on airships of any type.

Aerial navigation was made the object of special study, particularly on the part of astronomers, the necessary instruments were constructed, and for its practical application, courses for aviation pilots were instituted. The tables for the determination of the point, the lessons in aeronautics by Bianchi, and the

route indicator devised by Crocco might be mentioned in passing.

Meteorologists of the Army and of the Weather Bureau organized an Aerologic Service for the immediate use of the fighting armies on earth, on sea, and in the air, and specially interesting are the new methods for forecasting developed by Vercelli of the University of Turin.

In the field of marine engineering, especially in light craft for offense and defense, very notable results have been reached—from the engines to the hulls. In radiotelegraphy, naval and physical engineers have invented new instruments for the detection of submarines, and have sought to improve those already existing, in complete cooperation with the allies.

In wireless especially, the institutes of the Ministry of Posts and Telegraphs in Rome and that of the Royal Navy at Livorno have contributed to the study and to the improvement of the communication between the different belligerent units on earth, sea and air, and of transoceanic communication. Vallauri, of the Electrotechnical Institute of the Royal Navy, has published in the *Nuovo Cimento* a study on the functioning of vacuum tubes with three electrodes called *audion,* which can be considered as a first attempt at the theory of these tubes, which have many applications today in wireless.

In optics, precision laboratories were established under the direction of scientific men and the construction of optical instruments for war uses was improved in a notable manner. It may be sufficient to call to mind the work of the Galileo factory at Florence, especially in searchlights, periscopes and sighting instruments in general, the Filotecnica of Salmoiraghi in Milan, and the precision laboratory for the artillery in Rome.

For the sound ranging problem—that is, the determination of the position of the enemy artillery by sound—Garbasso, after the beginning of the war, founded the phonotelemetric service for use of our artillery, and in it several of our young physicists have found a field for technical and practical work.

In the field of photography there existed before the war a photographic section of the army, well known, especially for the works of Tardivo in telephotography and aerial phototopography. These immediately found application in war, and no matter whether from the air or the ground or the sea the photographic explorers, using the good apparatus designed and constructed by the section itself, contributed genuinely to knowledge of the enemy positions. Telephotography, especially in the regions of the Alps, was much used, and, when the censorship permitted, the results were in small part published, as for example in the panoramas of the war prepared under the direction of the Supreme Command of the Army.

Corbino and Trabacchi improved the working conditions of X-ray tubes, together with the application of devices for producing currents of high tension and of constant direction especially adapted to control them.

It was clear that Italian chemistry was ready when called upon. The already existing factories for explosives were enlarged and other large ones established, and our best chemists showed they knew how to push ahead and direct them, introducing new methods and courageously starting new ways of working. The numerous chemists who were selected for these war industries have given excellent account of themselves, as well as those who have been directing other industries also now engaged in war service.

Through the initiative of Prince Piero Ginori Conti, interesting studies have been made by Nasini and his students of the boraciferous "soffioni" of Larderello and of all the problems concerning boric acid, its byproducts and the gaseous emanations of the soffioni already used in various ways. The volcanic energies of our soffioni, unconquered and yet conquered by the will of man, donate to national industry with generous and singular abundance, boric acid, ammonia, carbonic acid, radioactive emanations, heat, vapor and pressure. Illuminated minds and generous hearts knew how to transform desolate and frightful regions into busy and prosper-

ous industrial centers, where every day the vapors let out into the atmosphere are steadily diminished, but the amount conveyed in pipes, conquered and utilized in every way, increases.

On account of the growing difficulty in importing nitrates from Chile, much has been done in Italy in regard to the problem of nitrogen, but its solution, important in time of war for explosives, in time of peace for agriculture, has been by no means easy, although we may mention the Rossi Factory of Legnano, gratified to-day by merited success along this line. The air has no political boundaries, and its nitrogen has no owners; it is this nitrogen which has to serve to fertilize our ground, which has to give us nitric acid for our industries. Our abundant waters, which are our natural wealth, must some day, when systematized and rendered obedient, supply the electricity necessary to feed uninterruptedly the cycle of nitrogen, to return the precious element from the inexhaustible atmospheric reservoir to the ground to intensify the agriculture and the life of our country, without limitations of commerce, of treaties, of transports, of possible mineral exhaustion.

Among the electrochemical industries, we have firmly established in Italy that of calcium carbide, and in electrosiderurgy, the Stassano electric furnaces, by means of which we have attained success in preparing many special steels and ferro-silicon. By means of the electrolysis of fused salts we produce aluminium in a certain quantity.

The dye industry has resorted to the preparation of certain simple colors; it has revived the manufacture of vegetable dyes and obtained brilliant results.

A problem for which Italy has found no solution is that of fuel, although we have tried all possible means to improve and increase to the utmost the few resources of our miserly soil. How insoluble the problem is can be understood by comparing the 800 thousand tons of poor combustible which our soil produces with the 11 million tons of fossil which we have to import in normal times, for the greatest part from England. To improve, to the greatest degree possible, this state of affairs, studies have recently been made of the hydraulic problems and the necessary legislation in regard to the waters, for the purpose of utilizing in the best possible way, our resources of white coal, which, in part at least, free us from the necessity of importing black coal from abroad.

An interesting study on the subject of black and white coal in Italy has been published by Novarese of the University of Rome in the *Atti della Società Italiana per il Progresso delle Scienze* in 1916. The extraction and the use of our fossil coals known by the name of *picee* or *black* and *xiloid* or *brown* lignites, have received during these years of war a very decided impetus, the unjustifiable objection to them, which the consumer has always had, having been overcome. The study of the various fields and their coordinate utilization has been of great advantage for war purposes in times of difficulty, and has demonstrated that our lignites, save for the manufacture of coke, to which they are not adapted, could be substituted, as far as there was an available quantity, for the imported fossil coals in all the uses to which they are applied in our country, and in not a few cases with noticeable advantages. Along this line, especially important are the recent studies made in the United States on the use of pulverized coal and on combustibles in general, on the subject of which a vast and interesting amount of material has been published in the *General Electric Review*.

According to Novarese our very modest reserve will acquire considerable value if, in the coordination of services which must come in the production of hydroelectric energy, it is employed as an auxiliary source to supply the deficiencies which are experienced in all hydroelectric plants more or less every year in periods of ordinary or extraordinary scarcity of water. Our coal, therefore, ought to represent a reserve for extraordinary needs, whether due to meteoric changes, or to other causes.

In order to make use of our hydraulic energy, the various sources available are being studied, and both the surface and the under-

ground hydrography of our country. The Institute of the "Regio Magistrate alle Acque" of Venice, similar to the one which existed at the time of the glorious Republic, and that of the commission for the study of hydraulic regulation of the Po river are examples of activity in this problem, activity which has already led to noteworthy results in several regions of Italy. An important study of the evolution of dikes for artificial lakes in high mountains has been made by Dr. L. Luiggi, with interesting comparisons between the dikes constructed in the various countries of the world, especially in the United States, and conclusions on the mountain dikes in the high valleys of the Alps and Apennines. In these valleys it may be possible to make numerous artificial lakes, in order to utilize better our hydraulic resources, whether to create electric energy, destined especially for the electrometallurgical and electrochemical industries, or to fertilize arid ground which, if irrigated properly, would produce more and better, or merely to drain unproductive or malarious regions, which with mechanical drainage could rapidly be put under cultivation.

The steel industry, which can not be attempted by us on the vast scale it is in other nations rich in iron and coal, has increased noticeably. During the war the siderurgical production of Italy was almost doubled in comparison with preceding years. We did not need to make changes in technical processes, but we completed plants for producing metallurgical coke and furnaces with apparatus for the extraction of by-products, increased the number of electric furnaces for steel, and constructed new hydroelectric plants or made use of energy from other societies already established.

In the medical sciences, the mobilization of the whole personnel and all the scientific resources in the country has met admirably the needs of the war; in our organized medical service, which is considered one of the best in existence, we have also found the time and means to make interesting researches and publish reports on them. The physiologists occupied themselves essentially with the problem of alimentation, and a scientific committee which applied itself to the various questions connected with the subject was appointed. During the war the studies and experiments of the physiologist Lo Monaco of the University of Rome were made on the action of sugar on the bronchial secretions. According to these studies, sugar in solution inoculated under the skin of those suffering from respiratory diseases, determines a rapid decrease in the quantity of bronchial secretion, which is gradually reduced until finally it ends completely.

In the field of the economic and political sciences, our studies and discussions on the principle of nationality are especially interesting at this moment. Senator Francesco Ruffini brought to light and discussed in one of his lectures another lecture given January 22, 1851, by Pasquale Stanislao Mancini, while exiled by the Bourbons, with which he inaugurated the first course in international law given in Italy. The title of Mancini's lecture is "On Nationality as Foundation for the Law of the People," and it has remained famous in the history of International Law, constituting probably the most modern and original page of the science of public law which has been written by an Italian hand in the past century. The economists and the men of letters of "Italia irredenta" have contributed in an efficient manner to the study and knowledge of all the problems which should find their natural solution in these times.

In the geological and geographical sciences, publications for actual and immediate use have been edited, such as the Report of the Commission for the study of Albania, and the studies on Dalmatia and Alto Adige. The Royal Italian Geographic Society has published the studies and conferences of Baratta, Taramelli, Martelli, Dainelli, Vinassa, Sillani and Tamaro, showing the Italian characteristics of those regions and presenting the justice of our aspirations.

Although this review is necessarily incomplete, yet it may be an incentive to look into the future and foresee what must be done to

continue the collaboration between the scientific and industrial elements of the country and the exchange of proposals and the united action for scientific and moral progress between the allied countries, specially what concerns the United States and Italy, who, during this war, have had opportunity to know and appreciate each other more thoroughly than before.

The institution, which, in the United States, is parallel to our Ufficio Invenzioni e Ricerche and the analogous institutions in France and England, is the National Research Council founded by Dr. G. E. Hale, which works as a scientific and research office acting as a department of the Council of National Defense.

In regard to the cooperation of the United States with the Allied countries we remember that on the entrance of the United States into the present struggle the following telegram was sent by Dr. Hale, foreign secretary of the American National Academy of the Sciences to the Royal Society of London, the Académie des Sciences, to the Accademia dei Lincei of Rome, and to the Russian Academy of Sciences, namely, to all the important scientific units with which the American Academy has cooperated for many years in the International Association of Academies:

> The entrance of the United States into war unites our men of science with yours in a common cause. The National Academy of Sciences acting through the National Research Council, which has been designated by President Wilson and the Council of National Defense to mobilize the research facilities of the country, would gladly cooperate in any scientific research still underlying the solution of military or industrial problems.

As a result of this invitation missions composed of men of science were exchanged by the various allied nations and a research information committee was established in the National Research Council, represented at Rome, Paris and London by scientific attachés at those embassies. Exchange of ideas and progress in their common work have been and are still continuous and constant. and, speaking especially of Italy, they have brought their results, although greater progress is expected with the increase in exchange of persons, ideas and facts.

The extended program of Dr. Hale for an interallied research council also plans for after the war an interallied institution that provides the means of reaching a common agreement as to what researches are most vital and ought to be begun because of the pressure of economic necessity or in light of recent progress, and has the privilege of selecting the countries or institutions best adapted to undertake certain researches and of finding the best methods to coordinate the work of the investigators of the different countries. This project was presented by Dr. Hale with complete success at the meeting of the academies in London. Thus were laid the foundations for a cooperation which will surely be fruitful of results, especially in the long work of readjustment and reconstruction which is going to begin with the desired conclusion of peace in the world.

GIORGIO ABETTI

ITALIAN WAR MISSION,
WASHINGTON, D. C.

THE PERSONAL RELATION OF THE INVESTIGATOR TO HIS PROBLEM[1]

As president of the local chapter it is my privilege to welcome you to membership in Sigma Xi and to say a few words concerning the main purpose of the society, the furthering of original investigation in science. I shall confine myself to the question of the personal relation of the investigator to his problem.

As a preliminary consideration it is well to emphasize the unlimited possibilities of scientific investigation. I have been asked by a member of our faculty, not in scientific branches, what scientists will do when they have discovered everything that is to be known about natural phenomena. The obvious answer is of course that instead of approaching such a consummation we are rapidly moving away from it. The number of things to be

[1] An address to newly initiated members of Sigma Xi at the University of Illinois, May 21, 1919.

investigated with profit is rapidly increasing and there is no reason to believe that there will ever be a change in this condition. The solution of any problem merely opens up new problems and the number of problems that can be effectively attacked is increasing in a geometrical progression. The formulation of new problems is therefore as much a function of research as the solution of problems already formulated.

Considering these facts we must realize that what we call the known is merely an infinitesimal part of what is to be known. Our systems of classifying facts, our so-called laws, are based upon partial views of the universe. At any time they may need revision. We should have no sympathy with the point of view expressed to me by one of my teachers when I was beginning graduate work in zoology. He said it was too bad that we were born too late, that we were living at a time when the great laws of biology had been discovered. He was referring to Darwin's theory of natural selection and went on to add that all we could hope to do was to elaborate upon Darwin's work and find additional examples of the law he had discovered. This remark of his has since reminded me of my boyhood regret that I had been born after all the great earthquakes and volcanic eruptions and great wars were over and I saw nothing ahead but a calm and dreadfully uninteresting future.

To my mind if there is anything that is clear it is that the great discoveries in science are still to be made, that while there has been great progress it is just a beginning. Nothing can be more fatal to our careers as investigators than the view that we are simply to elaborate the principles laid down by our predecessors. The whole spirit of research should be a continual revolt against this view, a continual attempt to find new and better modes of interpretation of phenomena. I feel safe in making this appeal because there will always be plenty of people who will follow the path of least resistance and they can be depended upon to pave the beaten paths and keep them smooth by rolling back and forth their truck loads of confirmatory observations.

Let me illustrate the value of the scientific imagination by an example from the biological field. One of the central problems in the field has been the question of the manner in which children obtain their hereditary qualities. The problem has been studied from two sides. On the one hand, an analysis of the adult characters of the children as compared with those of their parents and grandparents has disclosed certain so-called laws of heredity. On the other hand, a careful study of the minute structures and activities of cells, particularly of the sex-cells, has been made to see if the mechanism of heredity could be discovered. Each of these fields has yielded and continues to yield results of the greatest importance. It is interesting to find out that following crosses between certain kinds of individuals we may expect to get in the second hybrid generation certain kinds of individuals in definite ratio, but interest soon flags in the elaboration of the system and in the carrying out of the idea in endless variety. Likewise studies without end have been made of the microscopical structure of nucleus and cytoplasm, of chromosomes and centrosomes, of chromomeres and chondriosomes. The determination of a system by which we might describe the endless variety and relations of these structures is a task for numerous lifetimes.

The problems in these two fields are set. How easy to follow the beaten path, to polish off a paving stone here and there, to gain merited attention by developing a technique which will bring out some structures better than they had ever been seen before. But, whose soul is now fired by a new Mendelian ratio or by a new chromosomal number? Research in these lines became more and more a matter of routine, less and less inspiring, and there was danger that in these fields as in some others the investigators' main satisfaction would come from having faithfully put in his hours from eight to five. Why does he want to work overtime? Certainly not for the pleasures of contemplation of the beaten path. The inspiration comes from a vision of untrodden fields.

Returning to the example under consideration we find that the great spurts in the advance are due to the stimulation of the scientific imagination by hypotheses which aim to bridge the gulf between the two lines of research. The idea of a connection between the fact of the general equality of male and female parents in heredity, and the fact of equality in the nuclei of the male and female sex-cells was of epoch-making importance. Later the association of the precise though complicated behavior of the nuclear bodies called chromosomes with the possibility that these bodies are the bearers of the hereditary factors again caused a tremendous advance along both of the lines we have mentioned. More recently still, the hypothesis has been made that certain peculiarities in linkage of characters may be associated with peculiarities in the behavior of the parts within single chromosomes. If you will pardon my digression into this field I will elaborate the last step. According to the view that the chromosomes are the bearers of the hereditary factors it seemed clear that the factors located in a single chromosome must always go together and a corresponding linkage of adult characters in four groups corresponding to the number of chromosomes was made out for the fruit fly, *Drosophila*. But it was then discovered that the linkage was not complete. Occasional separation took place and the percentage of such separations was found to be definite for any two characters of such a linked group. Still further it was shown that knowing the percentage of such breakings of the linkage between characters A and B and between B and C the percentage of breaking of linkage between A and C could be calculated. It was either the sum or the difference between the first two cases. On this basis the factors in a linked group were arrayed in a linear series in which the actual breaking of linkage between any two points closely followed the expectation. Such a series was extremely interesting and the elaboration and perfection of the series in the various groups of plants and animals in itself would have furnished endless opportunity for research. But the interest in the series was immediately greatly stimulated by the suggestion that these phenomena of inheritance of adult characters could be explained by certain peculiarities in the behavior of the chromosomes. By this suggestion the fields of experimental breeding and of cytology were again brought into connection and there is gradually developing a fruitful hypothesis which in some respects bears the same relation to heredity that the atomic theory does to chemistry. Even if the direct hypothesis proves to be premature it will have been the means of opening up lines of research which otherwise would have remained untouched.

I have taken the time to give this example from the field of biology in order to emphasize my point in urging you to encourage any tendency you may have toward visions of relationship between things that at first seem to be wholly different. Young investigators are often inclined to think when an idea comes to them that it can not be of value because no one else has ever followed it up. Besides I have heard it said that it is one of the functions of a teacher of graduate students to see that they do not waste their time following up unprofitable ideas of their own. This would be very well but for the unfortunate consideration that to many, only well-established ideas are profitable, and therefore new ideas are always considered as unprofitable. This is stand-patism in science and the stand-patter in this field should have even less sympathy than the stand-patter in politics. Our salvation as original investigators depends upon the development of our own ideas. The question may be raised whether it is ever unprofitable for a person to follow out his own ideas. Is it not of more value to us personally to follow up an idea of our own even if it be wrong than it is to prove the truth of a dozen ideas suggested to us by others? But, *your* idea is not necessarily wrong and the fact that it is your own makes it extremely valuable. As your own it enables you to draw on the fund of extra energy which we all possess but which only a personal, living interest can draw out. Only such ideas, to use the words of our

constitution, can make us true "companions in *zealous* research." But beware lest you become so zealous as to forget that theses must be typewritten in a perfectly definite manner in order to be acceptable.

As to procedure in discovering what we call truth, I wish to describe two opposing methods, overdrawing the point at first in order to make the notion clear.

We may decide to investigate some problem that has been called to our attention and may start out to collect all the ideas of previous workers on the subject, to study completely all the facts which others have collected and to study also their attempts at explanation. Then follows a critical analysis of the facts and ideas to see if they are satisfactory and if not satisfactory the lines along which further evidence is desired. Then we proceed to the investigation of those points which seem to us to be necessary for completing the ideas disclosed in the literature of the subject. This method is one generally taught to young investigators but it has certain defects which are not so generally recognized. It puts the investigator in the position of patching up a structure that some one else has built. Nothing is more certain than that in building up a system by which to explain phenomena we at once focus our attention upon certain phases of those phenomena to the exclusion of others. Following this procedure a student of human embryology a hundred and fifty years ago, studying carefully what others had written on the subject, would have had his mind focused on the attempt to see in the egg or spermatozoon the miniature individual with all the mature parts in proper proportion; for according to the view then prevailing either the egg or the spermatozoon must contain such a miniature man. The chances are that he would believe that the problem to be solved is, whether the miniature man is in one or the other, and judging by the experience we have in our beginning biology classes he would have seen it. We have some marvelous figures in the publications of the seventeenth and eighteenth centuries of miniature men all nicely coiled up in the head of the spermatozoon and on the basis of such a figure who could believe that the egg is other than a medium for the proper nourishment and protection of the unfolding man. Especially was this likely to be the case in an age when all things feminine were considered inferior to things masculine. But even in those days there were feminists, for one group of investigators held that the miniature man was in the ovum and that the spermatozoon merely filled the compartively unimportant rôle of a stimulating agent which started the unfolding process of the ovum.

One danger then in this procedure is that it concentrates our attention upon certain phases of phenomena and upon certain ideas concerning them. Even the procedure of definition of terms, while necessary for progress in science has the very evil effect of concentrating the attention upon certain features of a process to the exclusion of others.

It has become the custom in certain graduate schools to put the student through a preliminary training for research on the theory that he ought to obtain a certain familiarity with the ideas of others before he begins to have any of his own. He is supposed to be unfit for any original investigation until he has had his fill of the prevailing explanations. I am inclined to object very strenuously to this program. To my mind it is all important that the personal relation between the investigator and the phenomena he is to study should remain unbroken. There should be allowance in any program of study for some fraction of the time when there may be companionship between the investigator and the phenomena of nature without the presence of a chaperon. It is not at the beginning of an investigation that a person needs to know everything that has been thought by others concerning the problem. Of course, it is all important that before imposing his ideas upon the world he should have tested them fully by comparison with all that others have done. It is to the neglect of the factor of personal reaction that we owe so much of the dead timber among would-be investigators. It is for this reason that we so rarely tap the fires of enthusiasm, that we do not unloose the reserves of energy,

which are waiting to be put into action. Enthusiasm is lost before there is a fair start in investigation. When enthusiasm is lost everything is lost, and the graduate schools are all too full of persons who are carrying out researches as a matter of duty and not as a matter of personal inward necessity.

No one can be a "zealous" investigator unless the investigation of some particular problem is absolutely necessary for his comfort, unless he is unhappy if not at work on it, unless there is an inner flame which will not let him rest. Such an attitude of mind can be obtained only by continued contact with natural phenomena, by a realization of the kinship with nature which makes us carry the joy of companionship from the realm of human beings to all nature whether living or non-living. We know the man who is interested in his fellow-men because he wishes to use them for financial gain. We do not wish to follow his example. The same type of man is to be found in science, the man who sees in nature only a means for obtaining material gain. The true type of investigator, however, is he who delights in the existence of a universe which yields secrets to his tender regard. I remember when I was a boy our neighbors used to bring their sickly house plants to my mother to keep for them until they regained full vigor. When asked why they did so well for her she always said, "They grow so well for me because I love them."

So let me urge upon you the cultivation of a relationship with nature and its problems based upon direct and personal intimate contact with it. The problems you are engaged in solving then become your own problems, their solution becomes necessary for your happiness. Your soul can not have peace until they are solved.

Charles Zeleny

SCIENTIFIC EVENTS

AMERICAN ASTRONOMY[1]

In the year 1840 the Dana House Observatory of Harvard College was established by the aid of public funds and private subscription, with William Cranch Bond as director. It was not the first college observatory in America, and other eminent American astronomers had lived earlier in the century, but the date may be taken as the beginning of systematic astronomical observation in the western continent. The U. S. Naval Observatory was established in 1844, and the present Harvard Observatory founded, largely by generous help from private benefactors, in 1846. Other institutions of the period might be named where the science of astronomy of position was pursued, and this, with the splendid work on planets, satellites, comets, asteroids, nebulæ and the astronomy of the solar system generally done at Harvard by W. C. Bond and G. P. Bond, and afterwards by Winlock, is to be considered representative of the astronomy of the United States in the succeeding forty years. The accession of the late Professor E. C. Pickering to the directorate of the Harvard Observatory in 1877 marks the beginning of the astronomical era in which we now live. Spectroscopy, stellar physics, and stellar statistics are the principal features. Professor Pickering's work was stellar photometry on a wholesale scale. Stellar spectroscopy and the determination of the radial velocity of stars by its means had been begun by Huggins in 1864; the photographic plate came into general use as an adjunct to the astronomer's equipment in the decade 1880–90, and these three items have formed the basis of the work of the American observatories of recent creation. The Lick Observatory, with the 36-inch telescope, was completed in 1887 at the expense, as every one knows, of an American business man. The Yerkes Observatory came into existence in 1897, and the observatory at Mount Wilson in 1904. These things are recalled at this moment because, during the past week, English astronomers have been gratified by a visit from a delegation of astronomers from across the Atlantic who were on their way to take part in the establishment of an International Astronomical Union at a conference now being held in Brussels (July 18–28).

At a meeting of the Royal Astronomical Society on July 11, specially arranged for the purpose, the visitors spoke in turn of the work

[1] From *Nature*.

on which they are each engaged, and the contrast between the astronomy of to-day and of sixty years ago is apparent. The absolute magnitude of a star or its actual luminosity independent of its distance is now a commonplace and forms the subject of many investigations. Certain peculiarities of spectrum have been correlated with the absolute magnitude in cases in which the latter is known, and, generalizing from this, a method has been devised for finding from the spectrum the absolute magnitude, and therefore the parallax, of stars. Professor W. S. Adams, to whom this conception is due, was constrained to say that the data on which his first list of parallaxes was based are capable of improvement, but this research is as yet in its early stages. Dr. Seares, also of Mount Wilson, has devised new photographic methods for determining the colors of stars, and a correlation between color, spectral type and absolute magnitude is being established. Professor Benjamin Boss, of the Dudley Observatory, whose name is associated more with geometrical astronomy than with physical, had some interesting facts to tell about the difference in direction of motion of the classes of stars known as the Giant and Dwarf, which is a distinction depending on luminosity.

Dr. Schlesinger, of Allegheny, and Professor Joel Stebbins gave details of their work in determining the variation of brightness of variable stars, the method of the photo-electric cell used by the latter being a very recent adaptation of physics to astronomy not unknown in England; whilst Professor Campbell, director of Lick Observatory and president of the delegation, refrained from speaking of his well-known observations of radial velocity, but told his audience of the observations of the Lick Observatory party on the occasion of the eclipse of June 8, 1918. An attempt was made to detect the Einstein effect, or a light-displacement effect from any cause, by comparison of a photograph of the stars round the sun with a photograph of the same field in the night sky, but the comparison failed to show any displacement of this nature. It is regrettable that the Harvard Observatory was not represented owing to the recent death of Professor E. C. Pickering.

This brief sketch of the proceedings at this meeting is sufficient to show the trend of modern astronomy. It was impressing to see so many men, comparatively young, who are devoting themselves to abstract science. That there is similar progress on this side of the Atlantic reference to recent volumes of the Monthly Notices will show. Here, as counterpart to the brilliant invention of new methods of attack by observation above recorded, we have development by mathematical theory and the statistical discussion of results.

ORGANIZATION OF THE AMERICAN METEOROLOGICAL SOCIETY

An American meteorological society is being formed and will be definitely organized at the A. A. A. S. meeting in St. Louis next December.

The *purpose* of this society is to fill the need for an easy interchange of ideas among those interested in atmospheric phenomena and their effects on man, and thereby to promote instruction and research in these important subjects. There never has been a national association in this large field in America.

The accomplishment of these objects may be brought about (1) by general meetings with the A. A. A. S., and local meetings at other times; (2) by using the *Monthly Weather Review*, the only meteorological magazine of the United States, as a medium for publishing meteorological and climatological articles, and (3) by issuing a monthly leaflet containing news, announcements, notes, and queries.

The principal sources of membership will be, teachers of meteorology (about 200), Weather Bureau employees (around 300), former Signal Corps and Navy meteorologists (nearly 600), and the numerous corps of amateur meteorologists. Dues of $1 a year should be sufficient to cover all expenses of the monthly leaflet and arrangements for meetings.

The need for considerable meteorological work in connection with military and naval operations during the war and our present expanding demands for weather forecasts not only at the surface but also at various levels in the free air makes the present the opportune time to capitalize the war-time interest

as a foundation for the great future needs of meteorology. I would be glad to have communications from prospective members of a meteorological society in order to have a strong, tentative organization and working plans for the formal establishment of this society.

CHARLES F. BROOKS

WEATHER BUREAU,
WASHINGTON, D. C.

SCIENTIFIC NOTES AND NEWS

AT the recent meeting of the American Academy of Arts and Sciences Professor Forest Ray Moulton, of the department of astronomy and astrophysics of the University of Chicago, was elected a fellow in the section of mathematics and astronomy.

AT the recent commencement exercises of the University of Georgia, Augusta, the honorary degree of doctor of science was conferred on Dr. John M. T. Finney, of Baltimore.

QUEEN'S UNIVERSITY, Belfast, has conferred the degree of LL.D. on Lieutenant-Colonel Ribert McCarrison, I.M.S., a graduate of the university, in recognition of his investigations into the causes of goiter and cretinism; on Dr. Johnson Symington, for twenty years professor of anatomy in the university, and now emeritus professor; the D.Sc. on Sir David Semple, late R.A.M.C., a medical graduate of the university, formerly assistant of pathology in the Army Medical School, Netley, and director of the Pasteur Institute, India; the M.D. on Professor J. G. Adami, F.R.S., vice-chancellor of the University of Liverpool, and lately professor of pathology in McGill University, Montreal, in recognition of his researches in pathology; on Dr. Alexis Carrel, member of the Rockefeller Institute of Experimental Medicine, New York, and during the war medical officer of the Special Research Hospital of the French Army; on Professor Harvey Cushing, of Harvard University; on Lieutenant-Colonel J. A. Sinton, V.C., I.M.S., formerly Riddell demonstrator in pathology at Queen's University, in recognition of his early distinctions and of his valor in the field while engaged in the treatment and succor of the wounded.

THE Navy Department announces the promotion of the following officers of the Medical Corps, Reserve Force, to the rank of commander; William Seaman Bainbridge, Robert Crier LeConte, William Baret Brinsmade, Stanley Stillman, Eugene Floyd DuBois, Rea Smith, John Chalmers DaCosta, Milton Joseph Rosenau, George Gorgas Ross, Albion Walter Hewlett, Hobart Amory Hare, Robert Battery Greenough, Judson Deland, James Eli Talley, Edward Milton Foote, Paul Adin Lewis, Guy Cochran, Verne Adams Dodd, Edgerton Lafayette Crispin, John Aloysius McGlinn, LeRoy Goddard Crandon, Harold Denman Meeker, Nelson Henry Clark, Halsey DeWolf, Charles W. Moots, George Arnold Matteson, James Taylor Hanan, Francis Joseph Dever, Frank Cousins Gregg, Clifford Elmore Henry, Porter Bruce Brockway, Clinton C. Tyrrell, Frederick Obadiah Williams, Harvey Mitchell Righter, Zachray Thomas Scott, William Curtis Newton, William Henry Areson. This is the first time in the history of the Navy that medical reserve officers have been ranked higher than Lieutenant Commander.

R. F. BACON, A. V. Bleininger, G. A. Burrell, F. G. Cottrell, J. O. Handy, G. A. Hulett, G. F. Mason, Samuel R. Scholes and Alexander Silverman have been appointed delegates from the American Chemical Society to attend the ceremonies, exhibits and demonstrations to be given at Pittsburgh, Pa., September 29–30 and October 1 at the time of the dedication of the new buildings of the Bureau of Mines.

DR. JACK J. HINMAN, JR., after having been on leave of absence as a captain of the Sanitary Corps in the A. E. F., engaged in water supply work, has returned to his work as water bacteriologist and chemist for the Iowa State Board of Health, and assistant professor of epidemiology in the State University of Iowa.

DR. EDWARD G. BIRGE has been appointed state epidemiologist of Iowa, succeeding Dr. John H. Hamilton, Iowa City. Dr. Birge is the son of President Birge of the University of Wisconsin.

Dr. Samuel T. Orton, of the University of Pennsylvania Hospital, has been appointed head of the Psychopathic Hospital of the University of Iowa, Iowa City.

The field party of the New York State College of Forestry, at Syracuse, has begun its second season of field work on the cooperative ecological survey of the Palisades Interstate Park. The field party, under the direction of Dr. Charles C. Adams, representing the College, and Mr. Edward F. Brown, representing the park, consists of Professor P. M. Silloway, who is continuing his study of bird tramping trails, in cooperation with Professor H. R. Francis, who is studying the general problem of park trails. The park fishes are being studied by Professor T. L. Hankinson, Dr. Adams and Dr. W. C. Kendall, in cooperation with the U. S. Bureau of Fisheries. Dr. J. Percy Moore, also working in cooperation with the Bureau of Fisheries, is studying the control of mosquitoes by fish. He is also making a study of the control of leeches. Mr. Walter H. Rich is making fish portraits and Mr. Edmund J. Sawyer those of birds. The field assistants of the party are Mr. Robert K. Fletcher and Mr. Winn Merrill. This cooperative survey is conducted by the College of Forestry, the Commissioners of the Palisades Interstate Park, and in part by the United States Bureau of Fisheries.

"Mathematics and Statistics" is the subject of the retiring address of the president of the Mathematical Association of America, Professor E. V. Huntington, Harvard University, to be given at Ann Arbor on September 4.

A campaign committee has made plans for raising funds for the erection of an Abraham Jacobi Memorial Hospital for Washington Heights, New York City. This locality has been chosen because of its lack of hospital facilities. The active campaign will not be begun until November. Dr. S. Robert Schultz is executive director of the campaign and has issued a call for volunteer workers. A resolution will be introduced in the board of aldermen at the first fall meeting, proclaiming Heights Hospital Week from November 15 to 22.

Appropriate exercises at the unveiling of the memorial tablet to the late Dr. Charles O. Zahner, professor of physiology in the University of Louisville, took place in the college building, June 26.

UNIVERSITY AND EDUCATIONAL NEWS

Dr. Bradley M. Davis, of the University of Pennsylvania, has been appointed professor of botany at the University of Michigan. He will take up his new work in October.

Arthur H. Blanchard has been appointed professor of highway engineering at the University of Michigan to occupy the chair recently established by the board of regents. He will retain his consulting office at Broadway and 117th Street, New York City, until September 15, after which he will be at Ann Arbor, Michigan.

Dr. Arthur C. Neisch, of Columbia University, has accepted a position as head of the department of chemistry at Queen's University, Kingston, Ontario.

Messrs. Frederick S. Dellenbaugh, Arthur L. Nelson and F. B. Philbrick, have been appointed instructors in electrical engineering at the Massachusetts Institute of Technology. Mr. Dellenbaugh was a captain of the Signal Corps in overseas service during the war. During the war Mr. Nelson was a lieutenant in the Engineer Corps of the Navy with important work relating to construction of power plants and supply of power at the submarine base.

Mr. E. A. Wildman has resigned his position as director of chemical research for Eli Lilly and Company, and has accepted the position of professor of chemistry and director of the chemical department of Earlham College.

Professor A. Findlay, of University College of Wales, Aberystwyth, has been appointed to the chair of chemistry in the University of Aberdeen in succession to Professor Soddy who has accepted a call to the University of Oxford.

THE University of Bristol has made the following appointments to the professorial chairs mentioned: *Botany:* Dr. Otto Vernon Darbishire, lecturer in botany in the university. *Education:* Dr. Helen Marion Wodehouse, principal of the Bingley Training College, Yorkshire. *Henry Overton Wills Chair of Mathematics:* Dr. H. Ronald Hassé, late fellow of St. John's College, Cambridge; senior lecturer in mathematics in the University of Manchester. *Mechanical Engineering:* Major Andrew Robertson. *Henry Overton Wills Chair of Physics:* Dr. Arthur Mannering Tyndall, acting head of the department of physics in the university during the war. *Henry Overton Wills Chair of Physiology:* Dr. George A. Buckmaster, assistant professor of physiology in the University of London.

DISCUSSION AND CORRESPONDENCE

TANDLER AND KELLER ON THE FREE-MARTIN[1]

IN April, 1916, the writer published a short article on "The Theory of the Free-Martin"[2] in which he sought to demonstrate that contrary to the then prevailing opinion the free-martin is a female, and that its intersexual condition is due to early embryonic anastomosis of the blood vessels of its chorion with those of the male twin, with consequent inversion, more or less complete, of the internal organs of reproduction by action of the testicular homones of the male. A detailed account of the data and theory was published in the *Journal of Experimental Zoology* in 1917.[3] At the time of publication the writer supposed that both the data and theory were new, but he has learned this summer by a reference in a work of Magnusson[4] that some of the data at least were anticipated by Tandler and Keller in a publication dating from 1911.[5]

These writers studied seventeen pairs of two-sexed cattle twins in fœtal stages and determined the following fundamental facts:

1. That such twins have a common chorion.

2. That branches of the umbilical vessels, especially the arteries, anastomose by relatively large branches, so that an injection from an umbilical artery of one fœtus would pass over into the umbilical arteries of the other. The females of such pairs possessed the typical "hypoplastic genitals" of the free-martin.

3. In one case, in which there was no macroscopic vascular anastomosis in the chorion and the injection would not pass over, both male and female possessed normal reproductive organs. The authors consider this more than a mere matter of chance.

4. That the maternal ovaries possess two corpora lutea, usually one in each ovary; hence they correctly interpret the twins as dizygotic.

5. The youngest pair of twins examined had a neck-rump measurement of 21 cm.; the female was typically malformed. Hence the origin of the condition is earlier.

From these facts the authors conclude that "vascular relationships and genital development stand in some kind of etiological relationship."

The writer independently stated all of these facts in his 1916 paper, and in addition the following facts and considerations:

1. A comparison of sex ratios of the four kinds of twins ♂♂, ♀♀, ♂♀, ♂♀, demonstrating from the statistics that the sterile free-martin must be zygotically female.

2. A study of much earlier stages than the youngest of Tandler and Keller showing that the union of chorions is secondary and that it probably occurs at or about the time of beginning sex-differentiation (20–25 mm.).

3. A statement of conditions of the fœtal membranes in twins of sheep, showing that, though the membranes fuse, no macroscopic

1 To the kindness of Professor A. Lipschütz, of Berne, the writer owes a reference to a later and presumably more complete account of the investigations of the same authors (*Wiener Tierärzlitche Wochenschrift*, III., Jahrgang, Heft 12, 1916), which however he has not yet seen.

2 SCIENCE, N. S., XLIII., pp. 611–613.

3 Vol. 23, pp. 371–452.

4 *Arch. f. Anat. u. Physiol., Anat. Abt.*, 1918, pp. 29–62.

5 *Deutsche tierärztliche Wochenschrift*, 19 Jahrgang, 1911, pp. 148–149.

vascular anastomosis develops and the female of two-sexed pairs is normal.

4. A brief description of some of the outstanding features of the anatomy of the reproductive system of fœtal free-martins.

5. A complete statement of the homone theory.

The writer regrets that he should have overlooked such an important contribution as that of Tandler and Keller. Its publication in a journal practically unknown to American biologists, and the fact that no reference to it was found in any of the other literature on the subject until after the war explains the occurrence. The writer's interest in the subject arose originally from the birth of free-martins in his own herd of cattle (from 1909 on); thus brought into immediate contact with the subject he realized its great biological significance and first took up its serious study in 1914. Proximity to the Chicago stockyards from which material could be secured in abundance was another inciting cause to its study.

The main, and very satisfactory, feature of the situation is, however, that the fundamental facts have now been determined from two entirely independent series of investigations, at least to the extent indicated, and that all doubt as to the general cause of this remarkable phenomena must consequently vanish.

FRANK R. LILLIE
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THE ANTISCORBUTIC PROPERTIES OF RAW LEAN BEEF

RECENT publications of Chick and Hume, Hess and Unger, Givens and Mendel, Cohen and Mendel, Harden and Zilva and others have contributed much to our knowledge of the etiology of scurvy and the antiscorbutic properties of food materials. It is quite generally agreed that normal development and well-being in animals are dependent upon certain accessory food factors, known as vitamines, of which there are, at present, three types: (*a*) fat-soluble A, a growth-promoting vitamine, the absence of which produces xerophthalmia and possibly other pathological conditions, (*b*) water-soluble B, a growth-promoting vitamine, the absence of which produces polyneuritis, and (*c*) the antiscorbutic substance, found in certain food materials, which Drummond[1] has named "water-soluble C."

Stefansson[2] in observing three cases of scurvy in his polar expedition, states that meat, and especially raw meat, prevented and cured scurvy while those of the party who subsisted, from choice, on carbohydrates, casein, cereals and a small amount of cooked meat, became afflicted with the disease.

This is not in agreement with the work of Chick, Hume and Skelton[3] or Pitz[4] for the former were unable to prevent the onset of the disease (in guinea pigs) by the administration of meat juice, while the latter made the same observation except that the administration of dry meat to the oats-milk diet delayed the onset of symptoms. Pitz attributes this to the better plane of protein intake, but we are inclined to believe that this is not the case, for he states that milk was fed *ad libitum* and it is generally agreed that the antiscorbutic properties of milk are proportional to the amount of milk ingested. We are also of the belief that those animals, described by Pitz, which showed improvement when fed meat and salt mixtures, drank more milk on account of the stimulation of thirst, with the result that the symptoms were delayed due to the increased amount of milk ingested.

We have found that, not only must the amount of milk fed in experimental scurvy be carefully controlled, but the diet of the cow is also a very important factor. We shall soon publish data to show that guinea pigs fed on oats and 20 c.c. of "spring milk" (daily) from cows fed on green grass and a

[1] Drummond, J. C., *Lancet* (Lond.), CXCV., No. 4963, No. XV. of Vol. II., p. 482, 1918.

[2] Stefansson, V., *J. Am. Med. Assn.*, Vol. 71, No. 21, p. 1715, 1918.

[3] Chick, H., Hume, E. M., and Skeleton, R. F., *Biochem. J.*, Vol. XII., Nos. 1 and 2, p. 136, 1918.

[4] Pitz, W., *J. Biol. Chem.*, Vol. XXXVI., p. 439, 1918.

grain ration, develop scurvy later, do not as a rule lose in weight, but on the contrary often gain in weight, live considerably longer and are in a much better physical condition, with the exception that scurvy usually develops, than those animals receiving 25 c.c. of milk from cows on a winter ration of ground oats, corn and barley, corn silage and alfalfa hay. We attribute this, tentatively, to the increased amount of fat soluble A in the "green grass" milk. We are now conducting experiments to ascertain the nature of this growth promoting substance.

In this preliminary paper we wish to state that our experimental work indicates, quite conclusively, that raw, lean beef does not possess antiscorbutic properties, so far as those properties can be tested by observations on guinea pigs. We have fed a cold water extract of meat representing 5, 10, 15 and 20 grams of meat, respectively, to guinea pigs receiving a basal diet of oats (ad libitum) and 25 c.c. of autoclaved milk. In all cases the guinea pigs developed scurvy just as soon as those animals which received nothing but oats and milk. When 5 c.c. of orange juice (daily) were added to the oats-milk diet and to the oats-milk-meat extract diet, all animals grew normally and no scurvy developed. We have not depended upon external symptoms and autopsies, solely, but have substantiated our findings by histological examination of the bones.

Owing to the fact that the guinea pig is a herbivorous animal, we have experienced some difficulty in being able to feed definite quantities of solid raw meat. By incorporating finely chopped meat into dry, rolled oats we have been able to show that scurvy will develop in practically the same time as when the meat extract was fed.

The experimental data will be published in the near future.

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AURORAL DISPLAYS

FOLLOWING a faint arch which was visible between 9 and 10 P.M. (75th mer. time), August 10, a crimson aurora extending over the northern sky and up to the magnetic zenith was observed here just before dawn, August 11, 1919. At 3:50 A.M. I noticed through the haze a curtain-like arch with a changing base which averaged about 15° above the horizon in the north, and with ends fading out in the east and west. At 4:00 A.M. a large portion of the western sky above 20° altitude became lighted with a vivid crimson glow. This coloring spread east above the whitish arch on the north until from 4:05 to 4:10 most of the northern sky from the zenith down to an altitude of about 25° was covered with it. The time of greatest brilliance was at 4:05 A.M., when whitish streamers were sharply defined in an arch which crossed the meridian between pole-star and zenith. These streamers converged at the magnetic zenith and formed a faint northern half of the auroral corona. After 4:15 the light of dawn augmenting that of the full moon dimmed the aurora till at 4:25 its last faint shafts of light were fading.

Whitish streamers were visible again at 8:35 P.M. about 50–60° up in the north, and for a little while there was a faint suggestion of an auroral arch: but the cirrus clouds, dense haze and full moon prevented further discernment of this display.

CHARLES F. BROOKS
CHEVY CHASE,
WASHINGTON, D. C.

AN unusual demonstration of the Aurora Borealis occurred at Ogunquit, Maine, on the night of August 11. The lights began at about 9:40 P.M. with the appearance of long, thin cloudlike masses extending horizontally a little west of north and about 25° above the horizon. This almost at once passed into curtain masses to the east, which remained less than ten minutes. The next (third) phase began by the sudden shooting up from the lower cloudlike masses of the long ribs of streak light which extended clear to the zenith.

These long vertical shoots of light presently extending around half the horizon, forming what was the most noted feature of the display for this locality; that is the continuity and great extent simultaneously over the heavens of masses of shafts of aurora half way about the horizon and up to the zenith where the light shafts met in a great cloud which momentarily shifted its form and extent.

Chromatic effects noted were pale rose pink and a delicate apple green. These were distributed apparently in local spots the green to east. A brilliant full moon added an unusual feature to the display. The lights faded suddenly about 10:15 P.M. and locally were not reported as of any moment later than that.

Aurora is not rare at this locality in August but this is the most extended demonstration seen by me here in some years.

FREDERICK EHRENFELD

OGUNQUIT, MAINE

I WAS very much interested in the descriptions of the auroral display of May 2, published in SCIENCE for May 23, and especially so in that of Mr. G. Irving Gavett, as it seems that I saw here in Washington, D. C., the same display that he saw in Washington state and at about the same time. I was observing with the photographic zenith tube of the U. S. Naval Observatory on that evening and entered a note, at about $12^h\ 0^m$ Washington sidereal time ($14^h\ 27^m$ G. M. T.). The display at this time did not strike me as unusual except in the brightness of the illumination. There was the usual northern arch and streamers and at one time, of which I made no note, a patch of very deep red in the northwest.

At $13^h\ 43^m$ Washington sidereal time, I first saw what was to me a very peculiar display. A band of light as broad as the Milky Way, but much brighter, extended from a point on the western horizon about ten degrees south of Pollux, passed just north of the Sickle in Leo, over Alpha Canum Vaneticorum and Corona Borealis and faded out on the eastern horizon about ten degrees south of Altair. It seemed nearly twice as broad at the meridian as at the horizon. The lights of the city illuminate the southeastern horizon considerably and the intensity did not appear as great there as at the zenith, nor did it seem as bright at the zenith as in the west. I made the note "bright as an army searchlight at $13^h\ 43^m$" for this part of it. It faded very rapidly until at $14^h\ 0^m$ Washington sidereal time it was "just discernible" in the west. But it brightened up again and at $14^h\ 15^m$ was as bright as the Milky Way in Cygnus on a very clear night and "traceable to the zenith." The band was broken into two parts between thirty and forty-five degrees from the horizon by a dark lane about one degree wide inclined at an angle of about fifteen degrees to the line of light and presented much the same appearance as the Milky Way in Cygnus in this respect also. The greatest intensity in this second maximum occurred at about $14^h\ 30^m$. The light at this time seemed to pulsate slightly after the fashion of some streamers from the northern arch. This was not pronounced, however.

During the whole display the position of the band remained practically constant. A slight change in the position of the band with respect to the Sickle in Leo was noted but this was attributed to the motion of the stars themselves as they were setting, the shift of the band being southward. I do not recall the appearance of the northern sky at the time of this display. If there was aurora there it was not prominent.

In *Popular Astronomy* (Vol. XXVII., p. 405), Mr. William H. Wagner describes the same phenomenon as seen from West Reading, Pa. From his description and by the use of a celestial globe I estimated that its parallax as seen from the two places amounted to very nearly twenty degrees. West Reading, Pa., is roughly one degree five minutes east and one degree twenty-five minutes north of Washington, D. C. From a consideration of this data, which is inherently approximate, I deduce an altitude of 275 miles above the earth's surface for the beam of light. Its width from north to south then was about 60 miles, and if it was continuous between here and Seattle, Wash-

ington, where Mr. Gavett saw it, it must have been nearly 2,500 miles long.

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MONKEYS AS COCONUT PICKERS

E. W. Gudger has recently called attention in Science to the use of monkeys as coconut pickers. The Malays and Bataks of Sumatra very commonly use monkeys in this way. The current English name there for the monkeys, *Macacus Nemestrinus*, is "coconut-monkey." The work of picking the nuts is performed in a way essentially the same as that described by Shelford and quoted by Gudger.

These monkeys not only work, but have a considerable commercial value as laborers. The price of a trained coconut monkey ranges from about \$8.00 to \$20.00; a price far above that put upon other common sorts of monkeys which are kept only as pets.

Coconut monkeys grow to a considerable size, and are very strong. They are also, usually savage, and will inflict a nasty bite whenever they have a chance.

Carl D. La Rue

Kisaran, Asahan, Sumatra

SCIENTIFIC BOOKS

Vital Statistics: An Introduction to the Science of Demography. By George Chandler Whipple. New York, John Wiley and Sons. 1919. Pp. 517. \$4.00 net.

Vital statistics have developed slowly in the United States. In spite of much progress in recent years, official records, including federal, state and municipal, still lack much in extent of the field covered and in detail of treatment. A nation-wide registration area for the recording and analysis of the elementary vital phenomena of birth and death is still unattained. A number of states and many of our cities of good size and of undoubted prosperity and economic development make no serious effort to collect the facts of their vital resources. It is no wonder then that we, in America, have lacked adequate text-books and competent teachers for the instruction of those interested in the science of vital statistics. Physicians who would profit most from knowledge of the subject receive virtually no instruction in this science. Health officers, in like manner, have only, within the last few years, awakened to the value of vital statistics as a mechanism in their work and only a few are competent to use it effectively.

Professor Whipple's book will, therefore, help to fill a long felt want. It is, frankly, a book for health officers. It is not intended for advanced students as a contribution to the method of statistics. It is rather a guide to those who would be familiar with the simplest methods as applied to the public health field. Only Dr. Newsholme's volume on vital statistics (now out of print) has been available for English readers during the last three decades. The present book, perhaps altogether more attractive in its mode of approach, will now serve American students and will present recent, often current, data concerning their own country.

The book may be divided into two parts; the first covers the technique of practical statistics, the second discusses the phases of vital phenomena of populations. The appendices give a rather incomplete bibliography, the model law for reporting diseases, births and deaths and logarithms of numbers up to 10,000.

The first section, pages one to ninety-nine, is a useful first aid to the student of the methods of crude statistical description. The usual devices and methods are described clearly and even pleasingly. This is obviously Professor Whipple's *forte*. He, as a sanitary engineer, has given proper place in his own writings to the graphic methods and to other attractive means of clear presentation of statistical materials. The student will, however, unless he carries his studies much further than the text, find himself only at the threshold of statistical method after he has covered this first part. Perhaps this is all that is intended by the author, who assumes no special mathematical skill or equipment on the part of his students. This section would ordinarily have given the greatest

difficulty in presentation. Professor Whipple has made it an attractive group of chapters, well written and even interesting.

Pages 100 to 458 are, in effect, a discussion of American demography. The chapters cover the methods of enumeration and registration; the characteristics of population; death rates, birth rates and marriage rates; specific death rates; causes of death, with especial reference to particular diseases and for specific age periods. Three chapters entitled, Probability, Correlation and A Commencement Chapter close this section of the book.

The elementary facts of the vital statistics of the United States are clearly presented in the above chapters. In fact, the author makes a special effort to hold his reader by simplicity, clearness and force of statement. Professor Whipple's book will not prove a difficult one for the student. It does not attempt too much along lines of thoroughness of treatment. Only the high spots are touched. Therein lies its value and perhaps also its danger. For while this book will undoubtedly increase the skill of the health officers in the presentation of their reports, it may also give many a feeling of competence greater than is justified by their skill. One would have wished that tuberculosis, cancer and a few other of the more important diseases had been treated more thoroughly in the light of recent contributions on these diseases. These could then have served as general models for the discussion of diseases as causes of sickness and death. In fact, the author has paid too little attention to the very important subject of the classification of the causes of death. This should be a vital matter to all health officers if they are to publish accurate statistics of the mortality of their respective communities. It is also characteristic of this book that the discussions are somewhat disjointed, perhaps because of the desire of the author not to overstrain the attention of the reader. We often find a subject treated in a number of places where a more continuous discussion would have left a clearer impression.

Altogether, this is a useful first course which, under competent laboratory instruction, should add materially to the popularity of vital statistics among health officers and others engaged in developing the public health movement in the United States. Professor Whipple will have earned the gratitude of those engaged in public health work if the book does what is hoped for it. This may be some compensation for the time which he, as a busy sanitarian, must have taken from his work in order to have made this text-book possible.

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A HISTORICAL NOTE ON THE SYNCHRONOUS FLASHING OF FIREFLIES

The interesting accounts of this remarkable habit published in Science during the past two years by Professor E. S. Morse and others have led me to make notes of similar accounts found in working up certain books on the East Indies and New Guinea. The excellent summary of our knowledge of this striking phenomenon published in Science for July 26, 1918, by Professor Morse, and the later communication from Mr. George H. Hudson led me to believe that these historical data may be of interest and possible value to those studying this habit in insects.

The first of these accounts was found in Robert W. C. Shelford's book "A Naturalist in Borneo" (London, 1916), a work replete with natural history data of great interest and value. At the time that I made a note of Shelford's observations, I had forgotten that Professor Morse in Science for September 15, 1916, had published Shelford's account from advance proof sheets of his book.

The next account I have chanced upon is from the pen of Nelson Annandale, the well-known zoologist of Calcutta, India. His paper, "Observations on the Habits and Natural Surroundings of Insects," made during the "Skeat Expedition" to the Malay Peninsula, 1899–1900 was published in the *Proceedings of the Zoological Society of London,* 1900.

From Part VI., "Insect Luminosity," the following extract is taken:

Of all the manifestation of luminescence among animals there is none more curious, or, in the present state of our knowledge, more inexplicable, than the manner in which large numbers of individuals of certain fireflies are able to display their light with absolute apparent simultaneity and unison and with regular intervals of darkness, under circumstances which make it impossible for all the members of the swarm to see one another. Even the power, possessed by some peculiar South-American beetles, of showing lights of different colors on different parts of the body at the same time is not more wonderful, or more conspicuous, than this. The phenomenon is not common on the east coast of the Malay Peninsula, where the soil is sandy; but it is said to be often manifested both in Siam proper and among the mangrove-swamps of Perak and Selangor in the west. I have only been able to see it on one occasion, and that was on the bank of the river Kuala Patani, one fine evening at the end of June.

A large tree was covered with many hundreds of fire-flies, the majority of which seemed, judging from the similarity of their lights, to belong to one species, or perhaps to one sex. There were three individuals seated together, however, whose lights were larger and bluer than those of the others. The lights of all the specimens of the more abundant variety flickered in unison with one another; those of the minority, the three individuals, flickered together also, but in a different time. At one instant the tree was all lighted up as if by hundreds of little electric lamps; at the next it was in complete darkness, except for three blue points. Then, again it was covered with white points, except for a little patch of darkness where the three blue points had been, and would be again immediately. A similar power of displaying luminosity in unison is said to be exhibited by some marine animals, even after they have been removed from the water; but the questions as to how this unison is effected and what is its exact object are obscure. The power by which it is regulated may be somewhat analogous to that which causes all the individuals composing a flock of birds to wheel at the same instant. As Professor Poulton has pointed out to me, the rhythmical display of light among a crowd of individuals appears much more conspicuous to the eye than the simple flickering of a number of independent points.

It will be noted first that Annandale's account is very circumstantial, perhaps more detailed than any account yet at hand. Secondly it should be noted that he writes that "it is said to be often manifested both in Siam proper and among the mangrove swamps of Perak and Selangor in the west." In other words this phenomenon is not so unusual in Malaya as might be surmised from its rare occurrence in our country.

Antedating Annandale by twenty years is an account by Burbidge of an excursion on the Scudai River, Jahore (Johore?), near Singapore. He says (1880) that:

The silence of the night was unbroken, save by the regular dip of the oars, and as darkness increased, the tiny lamps of the fireflies became visible here and there among the vegetation on the banks. As we glided onward, their numbers increased, until we came upon them by thousands, evidently attracted by some particular kind of low tree, around which they flashed simultaneously, their scintillating brilliancy being far beyond what I could have imagined to be possible.[1]

Still earlier than Burbidge we may find in Sir John Bowring's "The Kingdom and People of Siam: with a Narrative of the Mission to that Country in 1855":

How can I pass the fireflies in silence? They glance like shooting stars, but brighter and lovelier, through the air, as soon as the sun is set. Their light is intense, and beautiful in color as it is glittering in splendor—now shining, anon extinguished. They have their favorite trees round which they sport in countless multitudes, and produce a magnificent and living illumination; their light blazes and is extinguished by a common sympathy. At one moment every leaf and branch appears decorated with diamond-like fire; and soon there is darkness, to be again succeeded by flashes from innumerable lamps which whirl about in rapid agitation. If stars be the poetry of heaven, earth has nothing more poetic than the tropical firefly.[2]

[1] Burbidge, F. W., "The Gardens of the Sun: or a Naturalist's Sojourn on the Mountains and in the Forests and Swamps of Borneo and the Sulu Archipelago," London, 1880, p. 34.

[2] Bowring went to Siam as minister plenipotentiary to negotiate a treaty of peace and open up a

However, antedating even Bowring, the synchronous flashing of fireflies on the Meinam River had been described by another. In 1690, Engelbert Kaempfer left Batavia as physician to the Dutch Embassy to Japan. For some unexplained reason this embassy went to Nagasaki via Siam, and describing his return down the Meinam River from Bangkok in 1690, Kaempfer wrote:

The Glowworms (Cicindalæ) represent another shew, which settle on some Trees, like a fiery cloud, with this surprising circumstance, that a whole swarm of these Insects, having taken possession of one Tree, and spread themselves over its branches, sometimes hide their Light all at once, and a moment after make it appear again with the utmost regularity and exactness, as if they were in a perpetual Systole and Diastole.[3]

Another account is taken from John Strachan's "Explorations and Adventures in New Guinea," London, 1888. This account is not strictly in line with that preceding, since it seems to be of synchronous movement rather than flashing, but at any rate it seems worth while to quote Strachan briefly. Of the man and his book no information is at hand. On page 38 he writes of fireflies observed near the Fly River:

We sat gazing enraptured on a pyramid of living light, suspended, as it were, by threads of fairy gold. On a huge black walnut [?] tree there had gathered myriads of fireflies, which, moving through the dark foliage as if to the time of some enchanter's music, presented a scene of exquisite loveliness, which it is impossible to describe. As the fairy mass revolved, now up, now down, then round as to the measured time of a dance, my companion in ecstasy exclaimed "Captain, I would work twelve months for nothing to see such a sight as this."

way for British trading ships. He ascended the Meinam River to Bangkok and on this journey witnessed the scene described above. His book was published at London in two volumes in 1857. Our reference is to Vol. I., pp. 233–234.

[3] Kaempfer, Engelbert, "The History of Japan with a Description of the Kingdom of Siam," translated by John Caspar Scheuchzer, 2 vols., folio, London, 1727. This is best available to the general reader in the elegant reprint in three volumes of the 1727 edition by James McLehose and Sons, Glasgow, 1906. Our reference is to pages 78–79 of Volume I. of this edition.

The last notice that has come to light is distinctly of synchronous movement but it may not be amiss to quote it here. Burbidge on one of his trips to Kina Balu, the great mountain of Borneo, found the natives of Kalawat, a village near its base, raising bees in hives of hollow tree trunks set under the projecting roofs of their huts. Of these bees, Burbidge says:

The kind of bee kept is very small, much smaller than that common in England, and I was much struck at the peculiar manner in which they wriggle their bodies simultaneously as they congregated in groups on the hive near the entrance.

The above accounts are those that have been found in the course of reading for other ends, but it is more than likely that a systematic search through large numbers of books of travel in the East Indies would bring to light other accounts. At any rate those given indicate that there is a "literature" even though small of this remarkable phenomenon.

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SPECIAL ARTICLES

THE ORIGIN OF NERVE CELL PIGMENTS

The determination of the origin of the two recognized pigments of the nerve cell, the melanin and the lipochrome, has equal application to other somatic cells and correlates their normal and abnormal occurrence. The subject is therefore one of general biologic interest.

The melanin pigment is produced by functional depression of some duration in any cells. It has been fully excluded experimentally from normal function and overfunction, and also from the natural senescence which ultimately results from function (senility of excitation). In short, the nerve cell by its specific differentiation is never hampered in its normal processes by the permanent accumulation of waste products of metabolism.

The histogenesis of the melanin is from nuclear material, both intranuclear and the

chromidial apparatus, or the so-called Nissl substance. It is a true metabolic pigment.

The genesis of the melanin in depression explains satisfactorily its occurrence in conditions of frank disease as well as in abnormal physiological conditions. It happens in disease because the majority of abnormal stimuli are essentially depressant. Melanin is also an almost invariable concomitant of old age. Recognizing the dual forms of senility, senility of depression and senility of excitation, the melanin is introduced by depression, which is an almost inevitable factor in the production of the combined state as it occurs in an organism under ordinary conditions. In the separate experimental production, pigment is the most concrete point of difference between the two forms of senility.

Of particular interest to anatomists is the exploding of the tradition that melanin pigment is a natural structural constituent of certain nerve cells. Such old terms as substantia nigra and locus cæruleus apparently have given this idea its greatest plausibility. Also the bulk of human anatomical material is from old or diseased individuals. Still no two investigators have ever agreed, either on its time of development, or on the places of its consistent location. As a matter of fact, the melanin may be entirely absent from an adult nervous system, and even if present in some cells of a part, it may be absent in others. Such pigment-free animals are however scarce, for few have escaped depression. Extending this negative deduction to man, the cells supposed to be pigmented are the most obviously homologous with those of lower animals naturally pigment free, and it would be a most unique anomaly if man's differentiation alone should endow him with the useless.

The lipochrome, or as it has been more commonly designated in doubt of its origin, the fat-holding or fat-combined pigment, has been the object of more active investigation and discussion in recent years. Its characteristic is its reaction to the fat stains, Sudan III. and scarlet red. The prevailing opinions have been either that it is some sort of a by-product of cell metabolism, an "Abnutzung" or "wear-and-tear" pigment, as designated by Lubarsch, or that it is a more specific product of fat or fatty acid metabolism, the lipofuscin of Borst and Hueck.

The lipochrome turns out to be an exogenous pigment derived from the carotinoid pigments, namely, the carotin and xanthophyll of plants, which are ingested with the food.

It might seem surprising that so direct a connection has escaped identification. It has not escaped a surmise, as the original transferrence of the word lipochrome from botany testifies, but the difficulty was that certain of the earlier microchemical tests for lipochrome in plants failed in their application to animal tissues. The development of the chemistry of the pigments is bringing a progressive identification between plants and animals. The identification started with the isolation in crystalline form of xanthophyll from the yolk of the hen's egg and of carotin from the corpus luteum by Willstätter and Escher.

The knowledge of the relation of these pigments to animal metabolism has been extended chiefly by Palmer and Eckles and later by Palmer alone. They have shown that the natural yellow pigment of the milk fat, body fat, corpus luteum and blood serum of the cow is identical with carotin, while xanthophyll predominantly, with some carotin, colors the egg yolk, body fat and blood serum of the hen. Further Palmer has demonstrated a remarkable species difference. Species with colored fat, such as the cow, horse and hen, carry the pigments in the blood serum; species with colorless fat, such as sheep, swine and goats, do not carry the pigments in the blood serum under the most favorable conditions.

Palmer is also carrying on some conclusive feeding experiments on chickens. Chickens deprived from birth of carotinoid pigments show absence of the yellow pigment in their skin, fat, egg yolk and blood serum. Given the pigments in their food, the color is restored. If any fowl, yellow from its natural food, be deprived of pigment, the color fades, though the process takes some months.

Such findings so aptly provided for an intracellular occurrence of lipochrome that the working hypothesis for the nerve cell was based on them. The point that first focused our attention on the probable carotinoid identity of nerve cell lipochrome was its absence in the rabbit and dog. The rabbit and dog have colorless fat. Man and cattle, known to show intracellular lipochrome, have colored fat.

Verification was first sought in the chicken. With the use for the most part of Palmer's chickens above described, two series were run, the one lacking carotinoid containing food from birth, the other carotinoid fed. The carotinoid feeding ranged from a one week's introduction in a bird hitherto carotinoid free to a lifelong natural pigment food in others. In one half of the chickens of both series the factor of depression by heat, phosphorus, morphine or a rice flour diet was introduced to cover the side of disease.

The results were uncomplicated. Both normal and depressed chickens on any carotinoid diet showed the presence of the characteristic yellow pigment in all nerve cells. The carotinoid-free chickens lacked such a pigment in demonstrable amount.

However, this physiological demonstration of the introduction of carotinoid pigment demands for completeness the support of microchemistry. The question at once arises if the pigment introduced in nervous and other body tissues is identical with the lipofuscin, "wear-and-tear," fat-holding pigment described for the nerve and other somatic cells as specific. While it is true that the micro-chemistry of the lipochrome pigments is superficial, which is the reason that the analysis by that means has hitherto failed, yet it must be emphasized that it has become quite sufficient to demonstrate this identity. The application of this chemistry was more simple in our problem when following a means of providing or withdrawing the pigment at will. The yellow pigment introduced in nerve cells and the chicken skin, and the pigment of the carrot in frozen sections give the fat stains, the oxidation and decolorization by hydrogen peroxid and ferric chlorid, the fat stains after oxidation, and the rapid solubilities in fat solvents in common with a supposed lipofuscin; while the most characteristic test for lipofuscin, the Nile blue stain of Hueck, equally applies to known lipochrome before and after its oxidation. This supposed metabolic pigment of the nerve cell is then identical with a true lipochrome.

Finally in corroboration of the species difference in the transferrence of the carotinoid pigment from plants, the cow as well as the chicken exhibits it in nerve cells, while swine with their colorless fat line up with the rabbit and dog in a complete absence. Man, who is best known to exhibit lipochrome, is also known to carry carotinoids in his blood serum, and has colored fat. The consistency is complete.

The lipochrome pigment of the nerve cell is therefore a plant carotinoid, derived from the food, but limited to such species as carry the carotinoids in the blood serum. The conception of it as a "wear-and-tear" pigment falls to the ground with its demonstration as an exogenous and fortuitous pigment. The melanin of the nerve cell is a true metabolic pigment, derived from nuclear materials and produced by chronic depression. Because of this, the conception of a "wear-and-tear" pigment is to be transferred to the melanin, as conditioned by agencies without the cell, with a restriction to the abnormal.

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OFFICIAL FIELD CROP INSPECTION

Now, when it has been forcibly brought out that the nation is vitally interested in farm results and that to get maximum production, some system of efficient supervision is essential it may not be out of place to call attention to a line of work in which official supervision would be beneficial and for various reasons quite essential, even under normal conditions. There is a phase of farm cropping, especially with cereals, in which the state is not only vitally interested but could become of great aid to growers, and to the consuming public. That line of work may perhaps be properly named official field crop inspection.

Great strides have been made, from the educational standpoint, in crop improvement during the past twenty-five years. It is apparent, however, to those who are closest to the work that improvement in cereal cropping is not nearly proportionate to the general gain in information as to possible cropping methods. There is much knowledge as to tillage, crop rotation, seed breeding, and much improvement in farm machinery and methods of crop handling through farm machinery; yet the processes which, from a scientific standpoint are necessary to high production of yield and quality are not in common practise and, when used, are so intermittently followed as to cause failure of crop improvement that should otherwise naturally follow.

If the above is true, it is worth the attention of those of us who are specialists in certain lines of agriculture to try to determine the reasons for such failure to follow best processes and to arrive at a remedy along the lines which may result in getting the process constructively carried on.

For example, much work is done in breeding seeds. The states and nation are at much expense to allow certain experts to study Men-

delian methods of cross-breeding and other lines of work which result in the introduction of new varieties and kinds. Certain business men who are concerned with the results are not backward in saying that this introduction of varieties is often harmful rather than beneficial and those of us who are close enough to the field to note the results are perhaps willing to admit that many valuable varieties are so intermixed and so jumbled as to merit such disapproval.

It is safe to say that in cereal agriculture varieties are not kept separate, and are not handled in the same intelligent method as that which characterizes the best fruit and vegetable growing methods. Is there any reason why such should be the case?

Again, as I have pointed out in other addresses, though most agriculturists and many able farmers are convinced that a crop rotation is a necessary process for best seed and crop production in cereals, yet, there are few crop rotation series which are recognized for any particular region which are carried out with any consistency. There must be some general reason which accounts for such failures to apply the principles, methods and teachings which all of us and many able farmers believe in.

I do not wish here to enter into a discussion of crop rotation, soil tillage or purely sanitary matters of cropping, but will call attention to one phase which I think illustrates the way out, so that processes known to be necessary may be constructively continuous. I advocate a legal basis for bringing about stability and standardization of varieties in cereal cropping. I believe that there is good excuse for official supervision of seed production and distribution.

I am not, I believe, unduly optimistic when I affirm that under properly systematized seed standardization and sanitary cropping through means of proper handling of the soil and seed, any state or the nation might readily lift its annual average yield of wheat several bushels per acre per year. I think that a minimum increase of five to ten bushels per acre for proper systematic handling of the seed crop might not be beyond reasonable expectation. Further, I believe this would be doubly assured were it no longer possible for a man to plant the same general crop two years in succession on the same land. For the land control proposition, we may not yet be ready, but certainly, for the seed control proposition we have reached the stage when it is folly to claim that further improvement can be made by simple process of education when almost all the processes of marketing and general farm procedure are so conducted as to offset any improvement that can be made by intermittent educational processes, however effectively administered. I need not only call attention to the fact that there are very few new varieties of cereals which remain in reasonably pure form past the third generation on the farm and in the market. Very few of the wheats in the leading districts survive a decade before they are replaced by some new creation which runs perhaps only a shorter more precarious existence.

Opposition to Progress.—Many of us are prone to descant on the initiative being left in the hands of the farmer and many in the business world or manufacturing side are pretty sure to decry any attempt to improve matters by the enactment of law. I am quite convinced that laws which are enacted but never put into operation are useless. I am also convinced that those which are enacted and put into operation and which remain in operation, such as the sanitary laws for the control of Texas fever, smallpox and compulsory disinfection after diphtheria, scarlet fever, etc., are laws which should have been enacted and which, because they are still in force, prove that there was a necessity for such enactment. I also believe that it will be understood that many laws are enacted which do not need to be enforced. They form the educational basis for stable processes. Many good laws are self-operative. Such laws remain on the books as a basis and guide for those officials whose business it is to advocate progressive advance. Such law, for instance, is the ordinary anti-expectoration law. It was easy to make fun of and to say that it

was unnecessary and that everything could be done by education, but who among us will contend that such criticism or opposition was well founded?

Nevertheless, when we strike the matter of farming processes and indicate that there should be sanitary laws affecting farm processes, officially supervised by state officers non-amenable to politics, etc., there are many who object and say that such laws are unnecessary and that we should "rely on educacational methods," indicating that too much supervision will bring about stagnation, etc. Then there are others who are sure to call such laws "sumptuary," etc., tending to prevent individual freedom of action and toward depression of business operations.

In years past we have gone so far in this laissez faire line of non-control of farming matters that any approach to supervision by the state of any farming work is sure to be resented by some line of business, even though it meets with favor in the eyes of those for whom it is intended to directly help. Thus, for example, there are few of us but can remember the strenuous efforts to resist fertilizer control lines of work, and the strong opposition to enactment of horticultural and entomological supervision for control of insect and fungus pests, and to the enactment of simple seed inspection laws. Even now, in the work of plant disease control, it is apparent that there are yet those who insist that the state should keep out; that there should be no supervisory laws affecting control work. When, for example, but lately it was proposed that the states and nation should attempt control of wheat rust through barberry eradication, there were not a few who should know most as to the reasons for the necessity of such eradication, who spoke out freely and feeling in the advocacy of a "campaign of education" and as though we had not had that campaign for nigh on to two centuries. And now, if one should but propose compulsory seed treatment for cereals for prevention of smut and control of scab and similar cereal diseases, or a law simply to prevent continuous cropping of the land so that there might not be a continuous accumulation of such diseases in the soil and seed of special crops, there would be many so-called "educated men" who would throw up their hands in feigned horror. Yet enactment of such soil seed laws would be but a natural consequence following upon years of investigation and established knowledge relative to what should be done in order to control such cereal diseases. In other words, it would be but a natural step toward carrying out present knowledge of cereal control through sanitary methods so that the work done may not be continually and perpetually a loss through the carelessness of ordinary marketing and farming processes.

I discuss this phase of the sanitary question as to soil and seed only to introduce the idea of the necessity that the states attempt by law to standardize seed quality through proper methods of seed cropping and seed control.

I propose the thought that many of our so-called "educational campaigns" need a basis of equitable law. One can not expect sanitary or proper planning to be carried out merely on the suggestion of a professor from the agricultural college or of an extension worker if the carrying out of the processes must be placed eternally upon the utopian basis that the man who does the work may hope for some results but whether he does or does not get them he *should* and *is expected* to do it so that his neighbor may also prosper. Merely to recite to him that the public should have the benefit of the better crop that he will raise loses force after a time except it be backed by an emergency such as has come about under war conditions. It is too great a strain on the word "loyalty" to ask it, unless asked of all. In fact, the work will not be done with sufficient unanimity to give worth while results except it be done by all continuously, year by year. The proper basis for sanitation on the farm as to crops is not different from in the home, factory and school. It should rest on equitable law, educationally and equitably administered. I believe that the first step in cereal crop improvement rests in a further extension of

our state seed and weed laws and in the activity of the forces represented by them, to include proper control of seed crop production and of seed and grain distribution.

Present Status of Seed Production, Cropping and Marketing of Cereals.—In the line of cereal cropping and marketing we are not progressing as fast as the growth of our population calls for. The increase in population and of the population of the world, even in peace time, calls for a marked increase in cereal crop production. This increased demand has brought the total acreage of the wheat crop in the United States close to the maximum acreage at which labor is available for its production, and, what is worse, has reached such a high annual acreage in the chief regions of wheat culture that it is becoming extremely difficult to plan a rotation which will give sufficient improvement in the sanitary status of the soil as to crop refuse as to allow of seed improvement. In spite of our knowledge in the matters of sanitary cereal cropping no consistent steps are taken to bring about such uniformity and continuity as may be likely to tend to improvement either in the seed quality used in bulk, from year to year, or in crop quality.

These conditions result from: (1) The failure of our educational campaigns to prevent the constant cropping of the soil to one crop or its close disease infected cereal relations, and (2) the failure to hold varieties up to the standards of purity necessary to meet cropping and marketing needs. In the chief areas of cereal production, whether we mean wheat, oats, barley or corn, constant cropping prevail as against constant processes of sanitary crop rotation. Particularly in wheat, barley and oats cropping, the chief methods of production violate all the rules relative to standardized seeds more commonly than they are practised. Here the large acreage producers and the elevators and processes of marketing, speedily undo all the ideas of crop sanitation and grain standardization. At least, they speedily bring the entire mass to an equilibrium of minimum yield and uniformity of admixtures. As the country elevator furnishes the chief supply of seed for the general cropped areas, an area of wheat does not represent one of one variety but of several and of many types of infectious diseases which accumulate in seed and soil. In other words, we have no reliable basis of holding a crop to standardization; and the work of each cereal crop improver and public educator on breeding dies with him. As to the truth of this, one could cite many instances as Wellman, Haynes and Saunders.

These are strong assertions but are easily maintained to the satisfaction of any person who knows field and market conditions. In the corn states, corn culture is so overdone in large districts that the soil and seed is so contaminated with Fusarial types of fungi and other corn root and seed infecting organisms that the seed is generally reduced in vitality and the soil is so infected that in spite of the cultivation which is a necessity in that crop, good disease-free seed often fails to properly germinate in good *fertile* soil. This is but the story of the cotton crop, the flax crop and the wheat crop over again.

The Way Out.—Without attempting to further argue the matter, I propose in every cereal-producing state a law authorizing seed, field crop inspection, seed certification, seed standardization and seed sales lists, all to be done under supervision of an officer who holds his position not through local or political appointment, but because of his position as an investigator and educator associated with and directed through the proper educational board. The law should be of such scope as to afford the basis for proper educational propaganda which would come as a necessary adjunct of a law which should carry sufficient funds to allow of demonstrations and field work in the laying out of seed plots for standardization work. It should carry sufficient funds to allow of proper survey of every township so that there should be at least a local supply of seeds grown which may be looked upon by the residents of that township as standard stuff of a given variety, and so inspected that it is reasonably free from the infectious diseases characteristic of the crop. The law should be

equitably drawn and should be so worded as to allow enforcement in the face of wilful violation.

It is, I think, self-evident that the work of crop inspection, standardization, certification and seed listing should be free—open to all so far as done—for it is for the state, for all citizens, consumers as well as growers. Further, those who do the certifying and listing should not be dependent for their position on the number of bushels standardized, certified and listed. This is perhaps the chief argument against the fee system. No citizen should be able to charge or think that the *fee* pays for the work.

It may be asked why the necessity? Simply because: (1) The states and nation are creating many varieties, perhaps valuable ones at great expense, only to be lost inside a few seasons of general cropping and marketing through admixtures, disease contamination and deterioration. If not lost their qualities are quite camouflaged by the products obtained. (2) Seed inspection laws which only inspect in the bag or bin in the place of seed sales after the seed is sold off from the farm have failed and are failing to insure seed and crop improvement.

I do not mean by this that such inspection laws have not prevented the sale of much worthless seed. For under the present seed laws it has been possible to prevent the sale of large quantities of perfectly non-viable seed and it has been possible to prevent the sale of seeds containing quantities of noxious weed seeds. It is not in this sense that I claim they have not succeeded, but rather that inspection after the crop is sold can not improve the crop. Indeed, it may even deteriorate until there is really nothing worthy of the inspections and analysis wasted upon it. The seed merchant can only sell that which he buys and that which he buys can not be better than that the farmers grow. It is thus evident, if we are to improve that which is grown, the inspection must be commenced earlier and with the cropping processes. One can not improve that which is in the bin by inspecting it, he can only refuse to allow it to be sold until graded or cleaned, etc. As, however, the admixtures are usually such that cleaning machinery can not remove them, no amount of inspection will improve the breed and sanitary qualities for seed at this point. If the inspection starts on the farm and goes into operation with a view of aiding the grower to produce a better crop to be sold for seed for sowing purposes, or even for commercial purposes, then the money involved in the inspecting and in educating the public acts directly and readily leads to an improved pure-bred seed plot and within two to three crop generations to an entire farm crop of improved or pedigreed seed in sufficient quantity to fill wholesale seed house or manufacturing wareroom. A sufficient number of such properly inspected crops will provide for the township and county needs, and the process soon becomes infectious on adjacent farms. Thus standardization of varieties and proper recording of the growers may be established and through authorized lists the grower of improved or pedigreed seed may be brought into authentic touch with those who wish to use the seed on the land. Seed inspection thus becomes at once a constructive process for improvement of seed quality and a means whereby records may be established and kept so that the breed may not be lost through misrepresentation or ignorance.

Some may say that this can be done through cooperative breeders associations and by constantly renewed educational campaigns. That this is not possible, never has been done and can not be done because there is no tie to prevent such organizations running wild or dying when the originators die is self-evident and a fact of history. Such organizations usually die a natural death through the action of greedy members and false advertising propaganda. Who is there to check up the cooperative breeders associations? Seed improvement must last through the life of many men and for this there must be plans based on established law.

The one thing that can be said about our present haphazard method of breeding, seed recommendations and educational propaganda

is that all die out. Through this system or utter lack of system there has accumulated an enormous number of synonyms, and numerous varieties mixed and jumbled into junk lots and misbranded kinds and the nation quarrels as to how such cereals may possibly be graded for commercial purposes. These methods with the craze for introduction of new kinds and the accompanying fallacies that varieties run out have so beset our agricultural public and plant breeding workers that many able men are spending their time on the study of synonyms and the separation of varieties which, were the tasks accomplished, would be lost within three years should they cease their labors.

Even in potato culture there are getting to be so many varieties and so much disease contamination in the chief potato districts that one can scarce load a car of a single variety reasonably fit for use as seed or even commercial marketing without hand selection and disinfection. What then must be the status with reference to wheat, oats and barley?

The average person seldom sees anything smaller than potatoes and walnuts accurately, and this is literally true in regard to cereals. Some claim there is no necessity for such work because the national grain grades will eventually take care of this matter or should take care of it. Nothing can be farther from the fact. Nothing can be farther from possibility; for the national grades do not recognize variety. All hard spring wheat looks alike to the elevator and commercial man regardless of the variety. In milling and for feed purposes in actual fact, it should make little difference. These should not concern themselves with variety further than the matter of kind. For commerce and manufacturing national grades are an essential necessity in order that all may be properly safeguarded. They should recognize qualities as hard and soft, damp and dry, bright and mouldy wheats, etc., but they have little concern with variety. If they should, under present conditions there could not be constructed sufficient elevator bins to separate the varieties in any large cropping district. In fact they do not. The fact that a sample of wheat is of no. 1 cereal quality as "no. 1 hard spring," does not at all insure its seed value. It may bear all the weed infection, disease infection and types of wheat admixtures, to which that particular region is heir, and the more the national grading system attempts to separate varieties in the grading system, the more certainly will their processes be damaging to agriculture.

The seed proposition must stand on its own merits and must be recognized as separate from the manufacturing proposition. If we care for crop improvement we can not allow the seed standards in cereal cropping to be based upon national standards for flour and feed manufactury. Nor can we as agronomists allow those in charge of the national grades to claim without rough challenge that they are protecting the varieties. As long as our farmers believe or are taught to believe that they have some protection from this source it will be possible for our wholesale seed houses to buy "no. 1 northern spring" or whatever the designation may be and sell it back to our farmers for seed as a basis for crop production.

Field Seed Crop Inspection.—The process of proper field crop inspection for seed production and seed standardization is a very simple one when properly authorized and put into operation. It can be done under any conscientious educational official administration of the state and can be continuous from one generation of officers to another without loss of the underlying methods and records. The natural home of such crop inspection would be associated with the work of the agricultural college and experiment station, where experts should exist or where it should be possible to develop experts in seed and crop standardization. The work can very naturally and properly be centered around the work of the pure seed office of the state. In its essentials it consists in the sending of competent inspectors to inspect the growing crop of those who claim to be growing seeds for sale for sowing purposes or for special commercial enterprises. This inspection of the crop or stock may be

done at any time before the same is sold off the farm on which it is grown, but the proper time for such inspection is when the grain is in head, when even a novice in agronomic or botanical work need make no mistake as to variety and the percentage of possible admixture and the possibility of disease infections, as scab, rust, ergot, smut, etc. A certificate should follow final inspection of the seed in the pure seed laboratory following harvest and threshing. A state list should be published showing the name of the grower, his address, the variety and amount of seed saved for sale as seed and its authorization should be based upon the certificates as issued. Such state laws should specify various grades of improved grain as "bulk seed of sufficient purity for use in special commercial processes, or in general cropping as improved seed, or as pedigreed seed, etc."

Suffice to say that this state listing necessitates official records of pedigrees and makes possible standardization and retention of varietal standards of quality. The whole process tends to form a proper educational basis for seed and crop improvement. Finally, the lists put any man who wishes to use the particular seed in touch with the man who is able to provide it. Thus good seed gets used on the land. The grower and the public is assured against having the work of proper tillage and proper crop rotation destroyed or set aside through the use of false unknown or deteriorated varieties. The whole process tends to insure final crop standardization and is the necessary foundation for final establishment of marketing standards.

In North Dakota the process here outlined is not a matter of theory but has been in operation on a part of the crops since 1909, and quite extensively in operation since 1911. Some hundreds of thousands of bushels of seed have been sold under the state list. We have made a beginning step on the right road looking toward cereal crop improvement. When a farmer or wholesale seed merchant once becomes imbued with the idea of standardized seed of a known quality, sold under certification. and if necessary under lead seal, he at once sees the necessity of following other processes of crop improvement which follow as natural corollaries, thus one will not be apt to put such seed into the lands which are weed infected, disease-infected, or contaminated with other sorts of grains of the same kind, or junk the bulk product with inferior stuff on the commercial market. Improvements in lines of tillage and crop rotation must and will follow upon seed standardization as naturally as day follows sunrise. At present there is no real necessity of much improvement in tillage and crop rotation methods; for the seed used, very often, is of such quality from a sanitary and breeding standpoint, as to thoroughly offset any improvement that might be expected from better tillage methods, and improved methods in soil sanitation.

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A PLEA FOR COURSES IN PHYSICAL MEASUREMENTS FOR STUDENTS OF CHEMISTRY AND RELATED SCIENCES

It has been my privilege during the past two years to visit many institutional and industrial research laboratories in various sciences and I have had the opportunity of talking with many workers in these laboratories. Before that time I had spent a number of years in teaching and research in physics. Recollections of that experience, together with observations which I have since been able to make, have forcibly brought to my mind certain convictions which I desire to express, in the hope that such expression may contribute to establishing a basis for definite progress in certain kinds of research.

What is here set down may be common realization, and it may have been expressed before. If so, this will emphasize previous remarks upon the subject; and such emphasis seems to me to be much needed.

It is probably the experience of many scientific workers at some time or other to feel that they are much handicapped by being not sufficiently familiar with the methods and the

theories of other sciences which have a direct bearing upon the work in hand. In discussing the subject, I shall confine my attention to the importance of a knowledge of the principles of physics and of methods of physical measurement in their bearing upon work in other fields. No doubt the arguments will apply equally well, in their general aspect, to any science in its relation to the others. My reasons for emphasizing physics are, first, that I want to confine myself to the facts with which I am most familiar, and second, that many of the measurements and experiments made in almost any science are purely physical, involving mechanics, sound, heat, light and electricity with its newest branch, radioactivity.

In engineering, the fact that physics is fundamental has been universally recognized, in some cases by presenting a more intensive, or a longer course in general physics, and in other cases by putting into the curriculum intermediate and advanced courses having a direct bearing upon the problems to be encountered later. Engineering is commonly spoken of as applied physics, and it is therefore to be expected that physics and its applications should occupy a large part of the engineering courses. Workers in those sciences which have more recently become experimental, and in those which, though having long found much of their advancement in experiment, are finding new experimental methods—these have not yet fully recognized the aid they might receive from physics. On the other hand, the physicist himself has failed to recognize the aid which his science might give. Consequently little has been done towards promoting the idea of developing courses in physics with reference to its applications to the chemical, biological and medical sciences.

The handicap of insufficient familiarity with physical measurements and technique, in the case of so many workers in the sciences, is no doubt due to the fact that the great majority of students in these sciences become so absorbed in their own problems, and see in their own fields so many immediate things to be undertaken that they are led to pay but scant attention to any others. Or, on the other hand, students follow a prescribed course of study, which may have been laid out without sufficient consideration having been given to the value of including in that course the sort of training which later might prove extremely useful if not indispensable.

It is true that some recognition has been given physics in all undergraduate courses looking towards graduate work in chemistry, biology, medicine, and in some cases, psychology. The future chemist or bacteriologist "gets" one year of physics, consisting of three or four hours a week of classroom, lecture and laboratory work, and this during his freshmen or sophomore year. An extra year may be added, perhaps, in individual cases, for more or less advanced laboratory work, upon the planning of which the instructor has unfortunately often spent too little thought to bring out fully its possibilities from the student's point of view.

Those who plan such a prescribed course of study may justly argue that the year of physics to which their students are now "exposed," even in classes made up wholly of chemical or premedical students, is too frequently "just physics," and that no emphasis is placed upon the relation of physics to the science in which the student is interested. To a certain extent, this is true. The physics instructor's failing must be traced back to the same cause, however, as an effect of which his knowledge of the other sciences is insufficient to enable him to apply his physics in the manner expected. But aside from this, there is so much ground to be covered in a single year that, regardless of the text used, the class must be carried along at a terrific pace, following the text as closely as it may, in order to cover the ground in the allotted time. *After such a course, it can not be expected that a student should retain much in the way of ability to apply physics to anything else when, at the end of the semester, the sum total of physics which he can successfully apply to the impending examination is so small!* Besides, most of the courses properly include physics in the fresh-

man or sophomore year, and the interval of two or three years until research is begun blots out much of what was actually learned. Consequently, when the student has arrived at the research stage he must, with much loss of time and with much effort, rediscover methods and devise artifices which perhaps are well known in physical technique.

We must conclude that if the physicist has realized the fact that so many measurements are essentially physical, and that it would mean much for progress in all branches of science if those engaged in scientific research of any kind had at their command more physics, he has been at fault in not sufficiently emphasizing these facts and in not offering such a sequence of courses in physics as would recognize them.

Bearing in mind that the time which could be apportioned to such work would probably at best be limited, I should say that, in addition to the regular course in general physics, there should be offered a course, preferably during the senior year, which might be designated "chemical and biological physics." Such a course should be planned to give the student who contemplates graduate work, as well as the student going out into industrial work after his graduation, those principles and measurements which are known to be fundamental in the kinds of work that might be expected to follow. I should plan to have such a course occupy at least the equivalent of three two-hour periods for one semester of sixteen weeks. The following general topics might be taken as representing the essential things from which as many might be selected as were considered advisable, according to circumstances. (1) The accurate measurement of long and short time intervals. (2) Measurement of temperatures by methods other than the mercury thermometer. Principles of pyrometry. (3) Temperature regulation and temperature regulators and controllers. (4) Principles of precision calorimetry. (5) The microscope; its theory, and application to the measurement of small lengths. (6) The reading telescope and its application to the measurement of small angles. (7) Measurement of refractive index; spectrometer and refractometer. (8) The spectroscope, and spectroscopic analysis. (9) Color and colorimetry; intensity of light and photometry. (10) The polariscope and polarimeter. (11) The galvanometer; its use as a deflection and as a null instrument. (12) Ohm's law; measurement of current and potential differences. (13) Electric power and heating. (14) Resistance measurement; Wheatstone's bridge, with application to measurement of electrolytic conductivity. The alternating current galvanometer as applied to conductivity measurements. (15) The potentiometer; application to measurement of thermoelectric forces, electrode potentials, ionic concentrations. (16) Electrometers and electroscopes; applications to measurements in radioactivity. (17) Principles of X-ray measurements.

Fortified with the essentials of such a course, the student would be well grounded for the physics of almost any problem of research he might meet. Certainly the "general physics" course would fall short of giving him anything more than a somewhat hazy idea of the instruments mentioned in the above list, and of the purpose for which they are used.

Putting this work in the senior or first post-senior year would have the effect of attracting students who have come to realize the importance of these things in relation to their future work. A well-defined motive is much to be desired in any course, and, such a motive existing, the course should prove very successful from the viewpoints of both student and instructor.

Some of the measurements above mentioned are described—not at all adequately—in manuals of physical chemistry; but there the object of the experiment is the *result,* not the *theory* or *technique* of the measurement. The logical place for such a course is in the physics department, by an instructor who has thoroughly familiarized himself with the student's needs, and who knows what applications may later be expected of the kinds of measurements he teaches. Such an instructor, I dare-say, would render a valuable service to his colleagues in the other sciences in the capacity

of consultant, advising them upon the physical aspects of their research problems. Much satisfaction could be derived from putting one's best efforts into such work; for there would come out of it the consciousness of having rendered a valuable service to the cause of science.

Discussion of the question in these pages seems to me very desirable as an aid to the crystallization of ideas regarding it. It is hoped that eventually sufficient interest may be aroused in the idea of making physics more valuable, to bring about the establishment in our colleges and universities of courses along the line which has been pointed out.

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PATENT REFORM PROSPECTS

THE initial patent reform measures advocated by the Patent Committee of the National Research Council (as noted in SCIENCE, April 11, 1919, No. 1267, p. 356) have been introduced by Chairman John I. Nolan, of the House Committee on Patents under the following numbers:

H. R. 5011. Provides for the separation of the Patent Office from the Interior Department and its establishment as an independent bureau. This bill, if made a law, would take the Patent Office out of the position of one of a number of inconspicuous bureaus in a great department, and set it forth in its proper light as one of the really important branches of the government, exercising a vast influence upon the material and industrial prosperity of our people. It is believed this change would greatly extend the activities of the Patent Office with a resultant stimulation of invention in various lines, and that it would open the door to numerous important reforms.

H. R. 5012. Provides for a single Court of Patent Appeals. The purpose of this court is to shorten the processes of patent litigation and to unify the decisions rendered in patent cases.

H. R. 7010. Provides for increases in personnel and in the salaries paid in the Patent Office. This legislaton is shown to be absolutely indispensable, owing to present outside competitive conditions, in order to obtain and retain the services of competently educated men as examiners. Good men are resigning to take positions with big industrial firms paying large salaries. The Patent Office has long been working without a sufficient force of competent men; its work is consequently in arrears, and the work is done too hastily to be reliable. The bill provides for a considerable increase in the working forces, and fixes a range of salaries for examiners, running from an entrance salary of $1,800 up to $4,000 for primary examiners with corresponding increases for higher officers.

Public hearings on the foregoing bill were held, commencing July 9, by the mentioned House Committee. This committee includes at the present time the following Republican members in addition to Mr. Nolan: Florian Lampert (Wis.), Loran E. Wheeler (Ill.), Albert H. Vestal (Ind.), Wm. J. Burke (Pa)., Albert W. Jefferies (Neb.) and John C. McCrate (N. Y.). The Democratic members are: Guy E. Campbell (Pa.), John B. Johnston (N. Y.), John J. Babka (Ohio), Edwin L. Davis (Tenn.) and John McDuffie (Ala.), but not all members mentioned were present at any one session of the committee. Every member that attended participated to a greater or less extent in the asking of questions of the successive speakers, Chairman Nolan and Representative Johnston being especially attentive and active in this regard, frequently giving distinct assistance in the emphasis or qualification of points made.

As secretary of the National Research Council's committee, Mr. E. J. Prindle had perfected the arrangements for these hearings, and by him the successive speakers were introduced. The first of these was Mr. F. P. Fish, referred to as the dean of the American patent bar. The short address of Mr. Fish will long be remembered by those who heard it as a wonderfully candid, comprehensive and convincing general statement of the importance of the patent system, of its decline, and of the utility or intended effect of the remedial measures under immediate consideration.

On the second day of the hearings Mr. Prindle, having interrupted his own remarks on the preceding day in order that Mr. Fish might be heard, completed a general exposition of the bills. He seemed to agree with Mr. Fish in placing a primary emphasis upon

the need for a Court of Patent Appeals—for which he also advocated that shifting personnel proposed by H. R. 5012 and apparently regarded with some disfavor or doubt by the members of the House committee.

Dr. L. H. Baekeland, acting chairman of the Patent Committee of the N. R. C., presented the convincing testimony of a successful individual inventor as to both the importance of patent protection and the wastefulness of the present system—or lack of system—in patent litigation. He agreed with the preceding speakers in urging the indispensable importance of better support for the Patent Office. Mr. Baekeland was followed by former Commissioner Thomas Ewing, who emphasized the essential distinction between the *registration* system and the distinctively American or *examination* system of patent grants. Mr. Ewing pointed out that the effect of inaction on the part of Congress is the slow transformation of ours into a mere registration system, very discreditably camouflaged. He strongly advocated separation of the Patent Office from the Department of the Interior as indispensable to the normal development of the Office and the attracting of strong men to its service.

Mr. Ewing was followed by Mr. Wm. J. Kent, an inventor from the development department of the U. S. Rubber Co., Mr. Milton Tibbetts, Chairman of the Patents Committee of the National Association of Manufacturers, and Mr. Elmer Sperry, whose inventions include many applications of the gyroscope. Each of these contributed materially to a composite but unitary picture of the present deplorable patent situation. There was substantial agreement as to remedies.

On July 11, Judge Learned Hand, of New York, presented an earnest plea for the proposed Court of Patent Appeals. He was followed by the inventor Frank Sprague, who related personal experiences of very great interest and significance, and by Mr. W. G. Carr and Mr. D. W. Holden, formerly of the examining corps and now connected respectively with the Westinghouse Electrical Co., and with the office of the Thomas A. Edison Co. All of these gentlemen, in addition to advocating the bill under consideration, responded to questions bearing upon the alleged practise of suppressing inventions (of which Chairman Nolan presented the striking instance of the automatic telephone) and, also to questions bearing upon a proposal by Mr. Edison calculated to protect an inventor from the complete alienation of his rights.

On Saturday morning July 12, Mr. C. L. Sturtevant, secretary of the American Patent Law Association, presented several specific amendments to H. R. 5011, relating to separation, disbarments and the like, some of these being matters of detail to which the Patent Office Society had previously called attention; and Commissioner Newton presented incontrovertible statistics as to the need of increases in force and salary, mentioning that the rate of resignation had risen to something like 25 per cent. per annum, and that, in response to about one hundred calls made upon the Civil Service Commission, that body had been able to send him only about a half dozen qualified men.

On Thursday, July 17, Mr. Thomas E. Robertson, president of the American Patent Law Association, reviewed the whole situation, and on the day following he gave the committee a "demonstration" of the work of a number of the examining corps. Mr. Bert Russell, secretary of the Patent Office Society, was heard briefly in defense of a compromise proposal regarding the personnel of the Court of Patent Appeals, and in regard to specific features of H. R. 5011, regarded by him as important incidents of the proposed separation.

It is expected that the record of these hearings will shortly be printed as a House Document.

On the whole, the attitude of Mr. Nolan's Committee was felt to be distinctly encouraging, at least as to the reporting favorably of some sort of a Patent Court bill and some measure for the relief of the Patent Office.

No doubt the prospect of an early and favorable report of the bills substantially as advocated, and the prospects of passage when the bills shall be so reported, are still somewhat uncertain—especially since there exists a class

to whom the present low standards and confusion are profitable. It is however felt that inventors, scientists, engineers, manufacturers and others dealing with patents, share the Patent Office desire, and ought to have prompt, reliable service and adequate protection. The officials of the Patent Office have striven and are still striving vainly with inadequate, underpaid, everchanging forces to meet the demands upon the office. The time seems to have come when the public concerned must view the situation as one involving its own interests and proceed as it would in any other matter to secure what is right and just.

In a sense, "patent reform prospects" may evidently be said now to depend very largely upon the action of those "to whom these patents come."

Bert Russell,
Secretary Patent Office Society

SCIENTIFIC EVENTS

MEMORIAL TO THE LATE FREDERICK DU CANE GODMAN

A committee has been formed under the chairmanship of Lord Rothschild, F.R.S., to establish a memorial to the late Frederick Du Cane Godman, F.R.S., in acknowledgment of his lifelong devotion to the interests of natural history and in grateful testimony of the many valuable benefits conferred by him, in promoting the study of natural science in Great Britain.

At a meeting of the committee held at the Natural History Museum on April 30 last, it was resolved that the memorial should take, primarily, the form of a bronze tablet with medallion portraits of Mr. Godman and of the late Mr. Osbert Salvin, Mr. Godman's lifelong friend and collaborator in all his scientific enterprises, and that this tablet, with a suitable inscription, should be offered to the trustees of the British Museum, to be placed in the Natural History Museum, at South Kensington.

The committee hopes to be in a position to do something additional to perpetuate the memory of Mr. Godman, by helping to establish a less local form of memorial. It is the intention of Dame Alice Godman and her two daughters to found an exploration fund in the interests of the Natural History Museum. For this purpose they have offered to establish a trust with the sum of £5,000, the proceeds of which are to be devoted to making collections for the advancement of science and for the benefit of the museum. This fund is to be called the "Godman Memorial Exploration Fund." Dame Alice's project has met with the warm approval of the trustees of the British Museum. The committee, therefore, propose that any amount received by them over and above that required for the bronze tablet shall be added to the exploration fund. They also hope that this may form a permanent basis for future donations and bequests for the same purpose.

Mr. Godman's work is too well known to need any lengthy exposition here. He and Salvin commenced their zoological exploration of Mexico and Central America in 1860, and carried it on for over 40 years. The material so obtained was used in the preparation of the monumental work, "Biologia Centrali-Americana," consisting of sixty-three quarto volumes, which were published between 1879 and 1915. Of these, fifty-two are devoted to zoology, five to botany, and six to archeology. The "Biologia" certainly constitutes the greatest single work in natural history ever planned and carried out by private individuals, and rivals such national undertakings as the "Challenger Report," which, of course, was financed by the British government. The whole of the vast natural history collections on which the "Biologia" was based were presented by Messrs. Godman and Salvin, and (after the death of Mr. Salvin) by Mr. Godman, to the nation, unfettered by any stipulations, and these collections are now in the National Museum of Natural History. But Mr. Godman's services to science do not rest alone on the publication of his great work. The value of his gifts to the Natural History Museum, apart from the "Biologia" material, must amount to many thousands of pounds, and he was ever ready to help any undertaking for the benefit of his beloved science.

An appeal to him invariably brought forth a favorable response.

The committee will welcome the cooperation of Americans. Contributions should be sent to Mr. C. E. Fagan, honorary treasurer, Godman Memorial Fund, Natural History Museum, Cromwell Road, London, S.W. 7.

EXHIBIT OF MARINE CAMOUFLAGE

THE Brooklyn Museum *Quarterly* describes a special exhibit held at the museum of models, designs and other objects illustrating the practise and some of the principles of marine camouflage. The exhibition was arranged by the curator of the department of natural science, and was made possible through the interest and cooperation of Mr. William A. Mackay, of the United States Shipping Board, camoufleur of the Second Naval District, and Lieutenants Harold Van Buskirk and Everett L. Warner, of the Camouflage Section, Bureau of Construction and Repair, United States Navy. Numerous other naval officers, members of the American Society of Marine Camoufleurs, and others, also contributed to the success of the exhibit by lending illustrative material.

A series of photographs made in the naval laboratories at Washington, D. C., and Rochester, N. Y., showed successive stages of the experimental work by means of which the colors and patterns employed in the camouflage designs had been arrived at. These illustrations included views of the elaborate periscopic "theater" at Rochester, in which painted models of ships were tested under conditions which simulated, in all essential respects, the open ocean. The history of marine camouflage was briefly traced by means of labels and colored models, while approved as well as experimental designs of the "low-visibility" type, the British and American "dazzles," and the French system, were shown by means of models, photographs and colored lithographs issued by the Navy Department.

A case in the center of the exhibition room contained a miniature convoy of transports in charge of a cruiser and a flotilla of destroyers, each camouflaged model an exact replica of its namesake, or, rather, the original working model from which the transport or war vessel had been camouflaged. A simple, illuminated theater, equipped with a periscope, enabled visitors to observe a model as if from a submarine point of view, and, moreover, demonstrated surprisingly well the distortion and other types of illusion produced by the camoufleur's design.

THE PHILADELPHIA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fall meeting of the American Chemical Society will be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., under the auspices of the Philadelphia Section, from Tuesday, September 2 to Saturday, September 6, 1919, inclusive. The Philadelphia Section, situated, as it is, so near the center of our chemical activities, is planning an extensive and unusual program and hopes to rival the Buffalo meeting in interest.

The Rubber Division holds its first meeting, and a Dye Section is to be established which will function as a separate section this year. Philadelphia has a large number of chemical industries within its limits and in the surrounding territory, and its large and very enthusiastic local membership, together with the enhanced interest in chemistry manifest throughout the nation, insures a large gathering and an important program. It is already certain that the meeting will be one of the largest, if not the largest, in the history of our society, for we have not only a continually increasing membership, but a continually increasing enthusiasm for the accomplishments of our profession.

Registration will take place at the Bellevue-Stratford, beginning at 3 P.M., Tuesday, September 2. Information Bureau will be located at the Hotel.

The general program is as follows:

TUESDAY, SEPTEMBER 2

4 P.M.—Council meeting at the Bellevue Stratford.

7 P.M.—Dinner for the Council as guests of the Philadelphia Section.

WEDNESDAY, SEPTEMBER 3

9.30 A.M.—General meeting at the Bellevue-Stratford.

Address of Welcome—Honorable Joseph S. MacLoughlin, director of supplies of the city of Philadelphia.

Address by Secretary of War Newton D. Baker.

An address will also be given by a representative of the Navy Department.

2.30 P.M.—General divisional meeting.

8.15 P.M.—Smoker, Scottish Rite Hall, Broad and Race Streets.

THURSDAY, SEPTEMBER 4

9.30 to 1 P.M.—Divisional meetings.

2 P.M.—Excursions to industrial establishments.

8.30 P.M.—Presidential address: "Research and application," Dr. William H. Nichols, at the Museum of the University of Pennsylvania, Thirty-third and Spruce Streets.

FRIDAY, SEPTEMBER 5

9.30 to 1 P.M.—Divisional meetings.

2.30 P.M.—Divisional meetings.

7 P.M.—Banquet at the Bellevue-Stratford

SATURDAY, SEPTEMBER 6

Boat ride, tendered by the Delaware Section. (From 10 A.M. to 4 P.M.)

On Wednesday afternoon as a continuation of the general meeting important papers will be presented by members selected by each division. For the Biological Division, Dr. W. V. Bovie, of the Cancer Commission of Harvard University will present a paper on "Some Physiological Effects by Radiatoring Definite Regions Within a Single Cell." For the Fertilizer Division, Dr. H. J. Wheeler will speak on "Some problems and methods in agricultural research." For the Physical and Inorganic Division, Dr. W. D. Harkins will present a paper on "The structure of the nuclei of atoms and the two periodic systems."

The usual meetings will be held by all the Divisions, with the following special programs: The Industrial Division calls especial attention to its symposium on refractories being organized by Dr. A. V. Bleininger, of the Bureau of Standards, and the discussion which will be held upon Dr. B. C. Hesse's open letter concerning annual patent renewal fees for the United States. The officers urgently request members of the division to contribute to the general program of the division to make the Philadelphia meeting a notable one. The Biological Division will give much thought to chemo-therapy, which is a matter of great interest to the country at present. The Dye Section, which will be organized at this meeting, is preparing an interesting program on the dye situation.

CHARLES L. PARSONS,
Secretary

SCIENTIFIC NOTES AND NEWS

PROFESSOR GUSTAF RETZIUS, the eminent Swedish anatomist and anthropologist, died at Stockholm, on July 21, aged seventy-seven years. Professor Retzius's father and grandfather were distinguished Swedish professors of natural history and anatomy. He was educated at Upsala, and became professor of histology at Stockholm in 1876, and of anatomy in 1889.

PROFESSOR LAWRENCE BRUNER, after thirty years' service in the University of Nebraska, has retired from active charge of the department of entomology. Myron H. Swenk has been placed in charge of all entomological work in the state which comes under the board of regents, this including the department of entomology, the station activities, and the work in connection with the office of state entomologist.

MR. R. L. FARIS, assistant superintendent of the Coast and Geodetic Survey, has been nominated by the president as a civilian member of the Mississippi River Commission, to succeed the late Homer P. Ritter.

PROFESSORS J. M. BRYANT, S. E. Gideon, R. G. Tyler and H. C. Weaver, of the school of mechanical engineering of the University of Texas, who were absent on leave during the session of 1918–19 in war service, will resume their work in October.

IN the National Museum of Wales, Dr. J. J. Simpson has been appointed keeper of zoology and Dr. Ethel N. Thomas keeper of botany.

THE Baly medal of the Royal College of Physicians, awarded to the person who shall

be deemed to have distinguished himself in the science of physiology, especially during the two years immediately preceding, has been awarded this year to Dr. Leonard Hill.

THE Royal Society of Edinburgh has awarded the Makdougall-Brisbane prize for the period 1916–18 to Professor A. Anstruther Lawson, of Sydney, for his papers on cytology and on the gametophytes of various gymnosperms.

MR. J. C. HOSTETTER has resigned from the Geophysical Laboratory of the Carnegie Institution, to take up research and development work for the Steuben Glass Works, of Corning, New York.

DR. F. E. CHIDESTER, in charge of zoology at Rutgers College, until he entered the U. S. Public Health Service, is now engaged in investigations for the U. S. Bureau of Fisheries.

DR. RALPH B. SEEM, assistant superintendent of Johns Hopkins Hospital, has been appointed director of the Billings Hospital of the University of Chicago from January 1, 1921, and assistant consultant on the plans for the hospital.

MAJOR-GENERAL W. C. GORGAS, former Surgeon-General of the United States Army, who has been visiting Central and South American cities with a party of representatives of the Rockefeller Foundation, arrived from the Panama Canal zone at San Salvador on August 20, for the purpose of studying sanitary conditions in this city.

DR. J. WALTER FEWKES, chief of the Bureau of American Ethnology, left for the Mesa Verde in July to continue his work in the archeological development of the park.

MR. E. P. VAN DUZEE, curator of entomology of the California Academy of Sciences, and specialist in the hemiptera, has just returned from a sojourn at Huntington Lake, Fresno county, California. This lake has an elevation of 7,000 feet and the neighborhood is of special interest to entomologists on account of the great abundance of insect fauna. Nearly six thousand specimens were secured which will add a large number of species to the academy collection, some of which are new to science. Dr. F. E. Blaisdell, the coleopterist, accompanied Mr. Van Duzee and also made important collections.

MR. HOYT S. GALE, of the Geological Survey, who has spent several months investigating the potash resources of Europe for the Department of the Interior, has made a study of the deposits of Alsace and of Spain, and will study those of Stassfurt, Germany, before returning to the United States.

PROFESSOR E. W. D. HOLWAY, of the University of Minnesota, and Mrs. Holway, sailed from New York on August 16, on the *Santa Luisa,* for Valparaiso, Chile. They will collect the plant rusts (Uredinales) of the Andes from Chile and western Argentina northward to Ecuador, and expect to be gone about two years.

PROFESSOR DUNCAN S. JOHNSON, Mr. W. E. Seifriz and Mr. L. J. Pessin, of Johns Hopkins University, and Professor C. C. Plitt, of the University of Maryland, have returned from a two months' stay in Jamaica. Most of this time was spent at the Cinchona Botanical Station in the study of liverworts, lianes, epiphyllous plants and lichens. Cinchona proved an admirable place for summer work. In six weeks of June and July there were but two rainy days and three or four days with midday showers. The temperature ranged from 60° to 70° F., occasionally dropping to 58° at nights and once rose to 74° for an hour at midday. It is probable that the Cinchona Station will be available for American botanists during the year 1920.

THE University of Chicago has received a fund of $3,000 from the mother, brother, colleagues and friends of Edith E. Barnard, a former instructor in chemistry, for the endowment of the "Edith Barnard Memorial Fellowship in Chemistry." This fellowship has been temporarily provided through the aid of Mr. and Mrs. Barnard since 1916, but is now permanently endowed.

A NATION-WIDE campaign for funds to erect a hospital in New York City in memory of Dr. Abraham Jacobi is now under way. The

amount set by the committee is $1,000,000, a large part of which is to be devoted to endowment of the institution after it is built. The memorial to Dr. Jacobi, which will be for children only, will probably be erected as an annex to the Jewish Memorial Hospital, but will be non-sectarian in character. The committee desires to endow as many free beds in the hospital as possible as a tribute to Dr. Jacobi's labors among the poor of the city.

Captain Herbert C. Graves, hydrographer in charge of coastal surveys of the Coast and Geodetic Survey, died suddenly in London on July 26, at the age of forty-nine. He had been abroad since June 12 as a representative of the United States at the International Hydrographic Conference, and was also one of the delegates from the American Section of the proposed International Geophysical Union, which met in Brussels in July.

Sir Boverton Redwood, distinguished for his contributions to the study of petroleum, died in London on June 4, at the age of seventy-three years.

The death is announced of Mr. A. W. Ward, since 1889 professor of physics at Canning College, Lucknow, India.

Dr. José G. Herández, one of the most prominent physicians of Venezuela, and known for his scientific work, was killed at Caracas on June 30, in an automobile accident. A period of public mourning has been declared.

It is stated in *Nature* that the meeting of the International Research Council, which was opened at Brussels on July 18 in the presence of the King of the Belgians, concluded its labors on July 28. Much successful work was accomplished. The statutes of the International Council were finally agreed to, and unions embracing the whole subject of astronomy and the various sections of geophysics were formed. In other branches of pure and applied science proposals for the formation of international associations were discussed and formulated. These will have to be submitted to the authorities concerned in the different countries before they can be formally adopted. A resolution inviting the cooperation of nations that had remained neutral during the war was adopted unanimously. Brussels was selected as the legal domicile of the International Research Council. Its triennial meetings will be held in that city, and gifts or legacies will be administered according to Belgian law. But the associations dealing with special subjects will probably follow the established custom of holding their conferences successively in different countries. The secretariat of the council will be at Burlington House, where the Royal Society has placed a room at the disposal of the general secretary.

M. Basile Zaharoff has made a gift of 500,000 francs to the Paris Museum of Natural History to be used in its restoration, enlargement and improvement.

Chemists and assistants on the staff of the Health Department of New York City have joined the Union of Technical Men affiliated with the American Federation of Labor.

The University of California has received the Malcolm P. Anderson collection of scientific specimens of mammals and birds the gift of Mrs. Elizabeth G. Anderson, of Alameda. Mr. Anderson, recently deceased, was a naturalist who carried on field work in Asia for many years in the interests of the British Museum.

UNIVERSITY AND EDUCATIONAL NEWS

It is announced that Yale University will receive approximately $18,000,000, about $3,000,000 in excess of the expectation of the university corporation, from the estate of John W. Sterling.

Edward F. Searles, of San Francisco, has given stock valued at $1,500,000 to the University of California for its unrestricted use.

Dr. T. M. Putnam, professor of mathematics and dean of the undergraduate division in the University of California, has been appointed acting dean of the college of letters and science in the place of the late Professor H. Morse Stephens.

E. B. Brossard, Ph.D., has been appointed head of the department of farm management,

which was recently established at the Utah Agricultural College and Experiment Station.

M. E. GRABER, professor of mathematics at Heidelberg University, has been appointed professor of physics at Morningside College, Sioux City, Iowa.

DR. S. I. KORNHAUSER, formerly associate professor of zoology at Northwestern University and recently relieved from duty in the Sanitary Corps of the Army, has been appointed acting professor of zoology at Denison University in the absence of Professor Fish.

M. PAUL APPELL, dean of the faculty of sciences, Paris, has resigned from the office that he has held for sixteen years and has been succeeded by M. Houssay, professor of zoology.

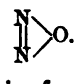
AT the University of Bristol, Dr. Otto Vernon Darbishire, lecturer in botany, has been promoted to a professorship; Dr. H. Ronald Hassé has been appointed professor of mathematics; Dr. Arthur Mannering Tyndall, professor of physics; George A. Buckmaster, professor of physiology, and Major Andrew Robertson, professor of mechanical engineering.

DISCUSSION AND CORRESPONDENCE

THE VALENCE OF NITROGEN IN NITROUS OXIDE

PROFESSOR W. A. NOYES in his address before the American Association for the Advancement of Science in December, 1918,[1] spoke very convincingly in favor of the theory of positive and negative valences. The work of Falk, Nelson and Fry in attempting to apply the conception of electrons to the theory of valence was commended and the theory of G. N. Lewis with regard to non-polar valencies in organic substances was justly criticized. While pointing out that some of our ideas need revision, Professor Noyes advocated a new formula for the well-known compound, nitrous oxide. According to Noyes, the formula should be $O = N \equiv N$.

Nitrous oxide, N_2O, is usually given the following structural formula:



According to this formula each nitrogen atom is given a valence of three, but two of the bonds from each nitrogen atom are arranged so that they neutralize one another. The oxygen atom is by common consent given a negative valence of two, so that the polarity (*i. e.*, sum of the positive and negative valences) of each nitrogen atom may be regarded as $+1$. According to the conception of positive and negative valences, and in line with Abbegg's assumption that the non-metallic elements exhibit maximum positive and negative valences the sum of which is eight, the nitrogen series embraces at least nine stages which, starting with ammonia, in which nitrogen has a negative valence of three, and ending with nitric acid, in which nitrogen has a positive valence of five, runs as follows:

$$NH_3 — NH_2 \cdot NH_2 — NH_2OH — N_2 — N_2O — NO — N_2O_3(HNO_2) — NO_2 — N_2O_5(HNO_3).$$

The commonly accepted formula for nitrous oxide, which is to be discarded according to Noyes, fits very nicely in this series. In Dr. Noyes's formula, to be sure, he would assume that one nitrogen has a positive valence of five and the other a negative valence of three and, since the algebraic sum of all of the valences on both atoms of nitrogen is $+2$, the average polarity of the nitrogen is $+1$ as in the old formula. It is obvious that this explanation is a little more complicated than that suggested by the old formula.

Professor Noyes justifies his new formula for nitrous oxide by an ingenious explanation of the way in which this substance is formed from ammonium nitrate. In ammonium nitrate, Noyes is willing to admit that one nitrogen has a negative polarity of three and the other a positive valence of five. When ammonium nitrate is heated, Noyes assumes that the salt is decomposed at first into ammonia and nitric acid,

$$NH_4NO_3 \rightleftarrows NH_3 + HNO_3.$$

The ammonia and nitrate acid then tend to form an isomer of ammonium nitrate,

[1] SCIENCE, 44, 175–182, 1919.

$$NH_3 + HNO_3 \rightarrow O{=}N\begin{cases}OH\\OH\\NH_2\end{cases},$$

but this compound is unstable and it loses water to form H_2N_2O,

$$O{=}N\begin{cases}OH\\OH\\NH_2\end{cases} \rightarrow H_2O + O{=}N\begin{cases}OH\\NH\end{cases},$$

and finally this H_2N_2O loses another molecule of water to form $O{=}N{\equiv}N$ in which one atom of nitrogen has a negative valence of three and the other a positive valence of five as in the original molecule of ammonium nitrate. In other words, neither atom of nitrogen has experienced any change with regard to its state of oxidation.

This hypothesis is certainly no more difficult to understand than many hypotheses which have been advocated in the past by chemists in both the so-called "organic" and "inorganic" fields. It is objectionable, however, because it assumes the formation of two very unstable, hypothetical, intermediate products. These intermediate compounds are certainly not very well known and there appears to be no proof of their formation during the progress of the reaction in question. Such a hypothesis is in line with the assumption of "nascent hydrogen" being formed when a chemical reduction is accomplished by a metal far above hydrogen in the electromotive series and it reminds one of the "primary products" which electro-chemists formerly believed to be formed as a result of electrolysis.

Such an explanation, moreover, is contrary to the evidence which can be deduced from the behavior of other ammonium salts upon ignition. It loses sight of the fact that nitrogen in its lowest state of oxidation is relatively unstable and easily oxidized and of the fact that nitrogen in its highest state of oxidation is easily reduced. In general, when an element is present in a compound in two states of oxidation, the decomposition of the compound is likely to result in the element assuming a state of oxidation intermediate between the two states in which it previously existed.

When ammonium dichromate is heated, nitrogen gas is evolved and chromic oxide is left behind. Heating ammonia sulfate results in the formation of nitrogen and sulfur dioxide. When ammonium nitrate is heated one atom of nitrogen is oxidized to form free nitrogen and the other is reduced to form nitrogen. In this case, Noyes would assume that neither atom of nitrogen is affected by oxidation or reduction but does not all our information with regard to the stability of ammonia and of nitrous acid make it seem simpler to assume that the polarity of nitrogen is zero when in the free condition rather than to insist that one atom has a positive valence of three and the other a negative valence of three?

Finally, Noyes claims that his formula seems more in accord with the ease with which nitrous oxide gives up its oxygen. As one writes the formula on paper it seems very easy to take away the oxygen from the $O{=}N{\equiv}N$ molecule and "organic" chemists always love to get atoms on the blackboard where they can easily erase them to show students how new compounds are formed, but it isn't quite clear why ammonium nitrate should withstand strong ignition without any effect upon the state of oxidation of either atom of nitrogen and yet after undergoing all this severe treatment, with the nitrous oxide retaining one nitrogen like that of nitric acid and the other like that of ammonia, be very susceptible to reduction. It would seem far simpler to assume that nitrogen with a valence of one is easily reduced.

The writer has respect for the views of Professor Noyes and has been under obligation to him in the past for helpful advice. He rejoices to learn that Professor Noyes is willing to accept much of the modern theory of valence.

WILLIAM T. HALL

CAMBRIDGE

A SNOW EFFECT

TO THE EDITOR OF SCIENCE: On March 3 of the present year a very interesting snow effect occurred in Orono and vicinity, which is perhaps worth recording in the columns of SCIENCE. The writer has not been able to find any one who ever saw a similar effect, and it

would be interesting to know if others have observed anything like it in other localities.

About four inches of light dry snow fell during the afternoon and night of March 2. Towards the end of the storm the flakes were very large and the wind blew at a considerable velocity. This high wind continued most of the day of March 3. After the sun had been shining on the snow for three or four hours and had probably formed a thin layer of moist snow on top, the wind would catch up a portion of this moist snow and roll it over and over, forming a snowball of increasing size until the gust of wind had spent its energy, or the ball had become too large to be rolled any farther. Some people who saw this process taking place said that the fields were literally alive with moving snowballs. This peculiar phenomenon continued until about noon and the fields around Orono and Bangor were left with countless snowballs everywhere. Back of each snowball could be seen the triangular shaped path, from which the snow had been rolled up. In one instance this triangle was found to be approximately thirty-six feet in length, but that was for an unusually large snowball. The snowballs were of all sizes, from two or three inches in diameter up to nearly two feet. Of course the largest ones were formed where the ground sloped so that the ball rolled down hill, but even on the level some of the balls were a foot or more in diameter. One ball in particular, on which measurements were taken and recorded, was elliptical in shape, the horizontal diameter being twenty inches and the vertical diameter being fourteen inches.

Leon Elmer Woodman

University of Maine,
Orono, Maine

ON MEASURING THE DENSITY OF THE "17-YEAR LOCUST" POPULATION

To the Editor of Science: According to the Bulletin of the Department of Agriculture No. 127, on the "17-year locust" of 1919 there was to be expected a very dense population of locusts this summer in the eastern and southern states. Brood 10 of the "17-year locust" and brood 18 of the "13-year locusts" are coincident this year. One of the items of interest in the periodicity of these insects is the number of individuals appearing from time to time.

I wish to suggest a means of measuring the numbers of them in a manner that will make it easy to compare the density of them from year to year.

Wherever these cicadæ are there is produced an incessant screech. The intensity of this "screechy" sound is dependent upon the density of "locust" population. A measurement of the intensity of this sound may be referred to the density of the population in the environment where the intensity of the sound is produced. This is applying "sound ranging." The proper environment would have to be chosen.

This means would at least afford an excellent way to record the activity of the cicada during any one season; and might be developed to give relative seasonal activity also.

Enoch Karrer

Bureau of Standards

SCIENTIFIC BOOKS

World-Power and Evolution. By Ellsworth Huntington. New Haven, Yale University Press, 287 pp., 30 figures. 1919.

This is a far-reaching book, written in an interesting style, and is suggestive of thought along new lines, not only to students of evolution (especially those interested in the accepted laws of heredity), but to biologists, paleontologists, physicians and statesmen as well. The underlying thesis of the study is organic change, largely brought about by the changing environment, chiefly climate, which affects the well being and health of organisms. "Training, heredity and physical environment are like food, drink and air." They are necessary materials and conditions that are at the basis of all life. Humanity "does not yet realize that the human species must be bred as carefully as race horses," and even when people inherit perfect constitutions their health must receive much care. That climate largely underlies human health, this book abundantly demonstrates, and that it is a *changing* climate that develops the strongest

and most intellectual peoples is clearly set forth.

The author asks:

Have religion, education, philanthropy and government failed? Shall we despair because the church, the school, the charity organization, and the state have not yet destroyed war, pestilence, lust, greed, cruelty and selfishness? Far from it. These agencies can not possibly play their proper parts unless science comes to their aid. Not mechanical science, although that has its useful part to play, but biological science. The sum and substance of biology is evolution, the Darwinian idea that no type of living creature is permanent.

In this book health is studied, not from the standpoint of the physician, but from that of the geographer and evolutionist. Fluctuations in health, even the rise and decline of nations, are found to be conditioned by changes in the climate, in a small way, by the daily and seasonal changes, and in the large by the sweeping climatic ones that historians have as yet made so little use of in their interpretations of the fluctuations in national prosperity. The expansion of great nations

is to a large extent determined by climatic conditions. We talk, indeed, about trade, but back of trade . . . lies the question of health. Health, however, depends chiefly upon air, food and water; and all three of these depend upon climate. Every nation that has been stimulated by an energizing climate has apparently spread its power over neighboring regions either by land or by sea.

The author establishes his argument in a study of Health and Business, followed by other chapters on Business Cycles in Foreign Countries, How Health does its Work, and Climate and Health.

The prosperity curve follows the health curve with no apparent regard for the crops. Contrary as it seems to our established convictions, there appears to be no way of avoiding the conclusion that economic cycles of adversity and prosperity in the United States depend upon health far more than upon any other factor. And health depends largely upon the weather.

Aside from a good inheritance, which is of course the first essential, good health depends upon three material factors—proper food, proper drink and proper air and climate.

Air is the first necessity of life. We may live without food for days and without water for hours; but we can not live without air more than a few minutes. Our air supply is therefore of more importance than our food or water supply, and good ventilation becomes the first rule of hygiene.

Huntington says that it is not enough to understand man's extremely sensitive adjustment to temperature and humidity. We must understand the effect of changes. A *variable* climate has utterly different effects from a uniform climate, even though both have the same average temperature and humidity. This thesis is developed in the section on The Importance of Variability. One of the best possible safeguards of health is constant change of temperature. "We need to return to the conditions under which the evolution of our unclothed ancestors took place."

In the chapter called The Voyage of Evolution, we read of the rise of the organisms into man, and that the last glacial epoch was peculiarly stimulating toward the mental development of humanity. "The coldest places were not favorable, but on their borders where the climate was severe enough to be highly bracing, but not benumbing, there occurred an extraordinary development of brain power." Then follow chapters in The Environment of Mental Evolution, The Origin of New Types among Animals, and The Origin of New Types among Men.

The culminating chapters of the book come next in order. First in the one on The Example of Rome, we are told that mighty Rome fell because "men's energy and power of self-control, as well as their crops, were suffering at the behest of the inexorably changing climate." The human world to the north was disarranged by the same climatic change, and "the barbarians were constantly swooping down first on one part of the empire and then on another." The enervated Romans could not overcome the more vigorous peoples of the north. "So Rome fell, and her fall was followed by that period of unfavorable climate which is known as the Dark Ages."

In the chapter on The Problems of Turkey, we learn that:

In ancient days, when the climate of the Turkish empire was favorable, the ancestors of some of the present inhabitants were the leaders of civilization. To-day their descendants are crushed and discouraged by the insurmountable obstacles of nature. No wonder their spirit is broken, their children ignorant, their religion corrupt, and their government diabolical.

Truly Turkey is the sick nation of Europe, and her civilization corresponds to her physical environment.

This does not mean that she is forever doomed to misgovernment, race hatred and massacre. It does mean, however, that there is little hope of any favorable development from within.

We now attain to the climax of the book in a consideration of Germany and her Neighbors, and the Great War. Racial character, Huntington says, "is the effect of physical environment acting upon generation after generation." The Germans are living in one of the most invigorating climates, one that is superior to that of her enemies who live east and south of them, and it has made them the virile and persisting people that they are.

No other nation in the world has so many people who live under a highly stimulating climate. The German devotion to the national cause is like that which made early Rome so formidable.

Wherever and whenever the climate is stimulating, civilization seems to rise to a high level. The character of the civilization of course varies according to the race and training of the people. Yet no matter what the race, it seems under such circumstances to acquire the power to originate new ideas, to stick to them until they are carried out, and to impress its rule and its civilization upon the less favored people with whom it comes in contact.

CHARLES SCHUCHERT

NEW ACTIVITIES IN THE HISTORY OF SCIENCE

THE active interest in the history of science which exists at the present time in Europe is indicated by the numerous publications which are appearing and announced in this field.

In Italy the journal *Scientia (Rivista di Scienza), International Review of Scientific Synthesis,* is in its thirteenth year of publication. The present editor is E. Rignano, whose works are favorably known to American readers. This is a monthly publication (subscription at 33 francs per year, Felix Alcan, publishers, Paris), with articles in French, Italian and English, but articles in Italian and English are repeated in French translation. The title indicates the purpose, synthesis of science, of the journal, particularly to counterbalance the ill effects of over-specialization and also to have due regard for the bonds of unity among the different sciences. The social sciences and the history of science are included within the program of this publication. It deserves the hearty support of all scientists, particularly the support by subscription of college and technical libraries and by individuals.

Professor Gino Loria has published for nearly twenty years the quarterly journal, *Bollettino di Bibliografia e Storia delle Scienze Matematiche* (Torino, Rosenberg et Sellier, Via Maria Vittoria, 18). The editor is notable among historians of mathematics as a mathematician of the first rank, contributing equally to the field of pure mathematics and to the history of the science. This journal is always interesting and instructive, particularly valuable to all students of mathematics.

In March of this year appeared the first number of a new Italian publication, quarterly, devoted entirely to the history of science, the *Archivio di Storia della Scienza.* The editor, Professor Aldo Mieli, of the University of Rome, is a well-known contributor to the fields of the history and philosophy of the sciences. Each volume of the *Archivio* will consist of about 500 pages (foreign subscription 35 francs, Dott Attilio Nardecchia, Via dell'Umilta, 14, Rome 19). While particular attention is to be paid to Italian science and scientists, all publications in the history of the various sciences and relating to the philosophy and development of science come within the range of the journal.

The first number contains the following articles and departments: G. B. De Toni, "Francesco Griselini, viaggiatore e natural-

ista veneziano del sec. XVIII."; Ant. Favaro, "Matteo Carosio (Amici e corrispondenti di Galileo. XLI.)"; Gino Loria, "Per una storia della matematica nel secolo XIX."; Andrea Corsini, "L'' influenza' oggi e nel passato"; Studi e Note Vinciane Proemio, D. T. Per l'edizione nazionale delle opere di Leonardo, Notizie varie; Bibliografia metodica dei lavori di storia della scienza publicati in Italia; Analisi critiche: R. Almagià, Cristoforo Colombo (G. Stefanini); U. Viviana, Andrea Cesalpino; R. Marcolongo, Il problema dei tre corpi; W. Libby, An Introduction to the History of Science (A. Mieli); Gli Scienziati Italiani, Aggiunte, note e discussiono; Notizie e Commenti: Organizzazioni italiane per promuovere lo studio della storia della scienza (A. Mieli). La storia della scienza nelle Università—Notizie varie.

Due credit must be given, even to-day, to the Germans for their activity in the publication of journals of an international character. However, Americans should now realize the desirability of stimulating and encouraging Italian, English and other European scientific publications of an international character. The revived Belgian journal *Isis*, now published by Dr. George Sarton and Dr. Charles Singer, of Oxford, should be remembered in this connection.

The best way to stimulate these publications is by personal subscription and by personal interest on the part of scientists in urging upon librarians the subscription to these enterprises.

Louis C. Karpinski
University of Michigan

SPECIAL ARTICLES

THE MOTION OF A GRAVITATING NEEDLE[1]

1. *Static Elongations.*—The apparatus[2] with which I am working is of the simplest character, but judiciously designed. Two shots ($m = .6$ gram), one at each end of a straw shaft 22 cm. long (diagram 1*a*), are supported by a long quartz fiber, fixed with cement above and below. The attracting weight ($M = 1$ kilog., or more) can easily be moved from one side to the other and definitely placed by a smooth-working crank mechanism, between stops. Observations are made in a dark room (except for distant lamp light), in a damp, semi-subterranean basement, in midsummer, with very fair constancy of temperature and no electric charges. The motion of the needle is essentially creeping with a period (if I may so call it) of 20 or 30 minutes. The scale distance is over 4 meters from the little mirror at the center of the shaft. The observer keeps out of the way.

Under these circumstances reasonably constant scale deflections, for periods of alternation exceeding 30 minutes would be expected; but the reverse of the case. Here is an example of the successive mean excursions or double amplitudes of the needle during the day:

July	16	17	18	19	20
Scale displacement in cm	2.79	3.02	3.27	2.79	3.65
July	21	22	23	25	25
Scale displacement in cm	4.03	3.64	3.07	4.50	5.39

The values of the morning and afternoon readings were equally different. Individual excursions may run as high as 6 cm. on certain days, though the behavior is throughout, of course, quite systematic.

2. *Triplets for three-minute Periods.*—The results for short period alternations of the pull of M (3 minutes in the examples given, Figs. 1, 2, 3) are equally bizarre; though, here they become interesting. In Fig. 1, the turning points of M are indicated by little circles, R and L are pulls to right and to left, respectively, and the mean double amplitude of the successive triplets are marked on the curves. There is drift throughout the figure; otherwise the behavior is about what would be expected. Inertia apparently carries the ball a little time after the gravitational pull has changed sign. But for this, there would be a phase difference of 90° as there should be. Moreover, the motion of the needle, after turning, is uniform.

[1] Advance note from a Report to the Carnegie Institution of Washington, D. C.

[2] *Proc. Nat. Ac. Sc.*, IV., 338, 1918.

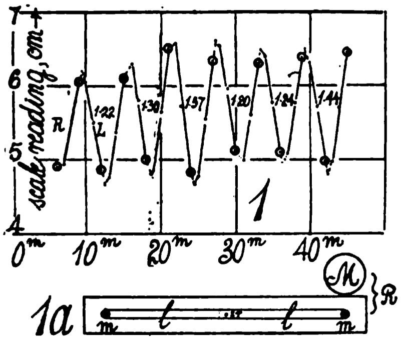


FIG. 1.

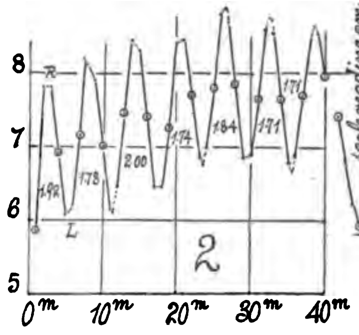


FIG. 2.

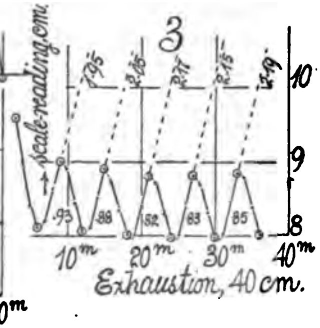


FIG. 3.

In Fig. 2, made under the same circumstances on a different day, the phenomenon is totally changed. The needle turns in the middle of the interval between the turning times of the pulling weight. There is no phase difference, while the drift has been accentuated. The triplets are larger, though the motion within the branches is still uniform. Similar observations were obtained with a downward drift. So I might adduce examples with all kinds of phase-differences, in some of which what was called "inertia" in relation to Fig. 1, comes just *before* the reversal of the pull! For the same reason alternations in periods of one minute each rarely succeed.

It is obvious therefore, that in addition to the gravitational attraction there is in all these cases evidence of the development of an attractive (or in Fig. 2, of a repulsive) force more or less rapidly after the weight is turned.

3. *Radiation.*—The extraneous forces originating in M are clearly referable to radiation. We may argue plausibly that, if M be warmer than m, there is excess of convection on the M side and a corresponding part of the pressure is converted into kinetic energy. Attraction apparently results. In the opposite case (colder M), there is repulsion such as is evidenced, for instance, after the semi-periods in Fig. 2. The relative magnitude of the radiation forces is astonishing. One has merely to warm the ball M with the hands, in order to increase the "gravitational attraction" five or ten times. Again on cooling the ball in tap water only a few degrees below that of the room, repulsion may be obtained. Thus when the external temperatures are increasing even if very slowly, outside objects like M are hotter and the excursions of § 1 are large; and vice versa.

The warmer ball remains effectively though decreasingly so, for hours, even when it has become cold to the touch. Normal experiments are not again feasible until the day after.

4. *Radiation in Vacuo.*—At this point it was therefore necessary to build another apparatus, capable of being exhausted. This was done, and experiments similar to the last performed, by exhausting the interior in successive steps of 0–10 cm., 10–20 cm., etc. Thus again the interior was cooled relative to the exterior and there was an influx of radiation, the character of which was made evident by hanging the needle somewhat obliquely to the vertical walls of the case.[3] The ball M was discarded. It was found that the attractive forces obtained in each of these successive steps of exhaustion (allowing the needle to get back to equilibrium before the next step) gradually diminished with the decrease of pressure, until between 60 and 70 cm., there was no appreciable effect. For higher exhaustions (70–74 cm.) the attractive forces were reversed and became strong repulsive forces.[4] In other words at this point the radiometer forces supervene

[3] I give this explanation with some reservations. All that is in question is a reversible inequality of radiation on the two sides.

[4] Deflections of +15 cm. and —15 cm. were observed, respectively, at the first and last drop of pressure, whereas the gravitational deflection is but 3 or 4 cm.

and the pressures are larger on the warmer side of the needle. It follows therefore that one can eliminate the radiation discrepancies by work done in partial vacuum. In fact with the exhaustion somewhat below 70 cm., I heated the ball M (restored) as far as was safe, 60°–70°, without obtaining any appreciable effect on the needle. This suggests the method of obtaining trustworthy static data.

Exhaustions of even 40 cm. give very good results. In Fig. 3 for instance, obtained with the new apparatus (scale distance 265 cm., therefore less sensitive), there is no drift and the whole motion soon becomes steady, so that the triplets (data given on the curve) become repetitions of each other. Between the turning points the motion is uniform.

A further important result was substantiated. The size of the triplets, or better the speed of uniform motion between the turning points was the same, independent of pressure, from a plenum up to 70 cm. In Fig. 3 some of these speeds are given as displacements per 5 minutes inscribed on the lines prolonged. Improvement would not be difficult. Hence these resistances independent of the pressure or density of the air must be due purely to the viscosity of the medium and it must be possible to express the gravitational attraction in terms of the viscosity of air. This project is further elucidated tentatively, in the next paragraph.

5. *Tentative Estimate.*—The resistance experienced by a sphere of radius, r moving in a viscous fluid (η) with the velocity $v = l\omega$, is well known to be $6\pi\eta rv$. I do not happen to be familiar with the corresponding expression for a cylinder of radius r, semi-length l and with hemispherical ends, moving broadsides on. To get a mere order of values, however, I will postulate, that for equal frontal areas,

$$\pi r^2 = 2r \cdot \Delta l$$

the resistances are alike. Thus the element of resistance is

$$dF = 6\pi\eta rv = 6\sqrt{\pi}\eta l\omega\sqrt{\pi r^2} = 6\sqrt{\pi}l\omega\sqrt{2r \cdot \Delta l} = \omega\eta\sqrt{24\pi r\Delta(l^3)}$$

and this is to be integrated for the double length of the needle ($2l$). To carry out the integration put $l = n \times 2r$ where n is a serial number. The equation becomes

$$\Delta F = 8\omega\eta r^2\sqrt{3\pi\Delta(n^3)}$$

and the problem is reduced to the summation of a series of cubes

$$2\sqrt{\Sigma n^3} = n(n+1),$$

the length being $2l$. Hence finally for two masses M, m, at a distance R apart, disregardin corrections,

$$\gamma = 8\sqrt{3\pi}\eta\omega(R^2/Mm)n(n+1).$$

The constants of the second apparatus were:

$$M = 1602 \text{ grams}, \quad m = .563 \text{ grams},$$
$$R = 5.1 \text{ cm.}, \; 2r = .4 \text{ cm.}, \; 2l = 22.8 \text{ cm.}, \; \eta = .00019, \; n = 28.5.$$

In Fig. 3, the last three scale rates have the mean value 2.17 per 5 minutes, or

$$\omega = 2.17/300 \times 530 = .00001364$$

radians per second, the scale being off 265 cm. Inserting these data into the equation, $\gamma = .10^{-8} \times 6.2$, which is much closer to the standard value than, from the improvised apparatus and inadequate theory, I had expected to get. It sufficiently substantiates, I think, the assumed purely viscous character of the resistance and moreover shows that the constant of gravitation may probably be found, with precision, in terms of the resistance, in air, to the uniform motion, broad-sides on, of a cylinder with hemispherical ends.

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RESEARCH AND APPLICATION[1]

FOR nearly half a century, it has been the custom in this society to give its president every year "his day in court," and in conformity therewith many brilliant addresses have been delivered, and almost every conceivable subject has been discussed. It is therefore becoming more and more difficult for the incumbent to select a theme which shall have the merit of novelty, unless, perchance, he is himself working in the laboratory, and can bring forth some new and shining example of the progress of his science. I have not the good fortune to be so situated, and I must perforce satisfy myself with some other line of procedure in the hope that even in a discussion of old and well-known facts, some new light may be thrown, which will not be altogether without value. I have therefore selected for my subject, "Research and Application," knowing that many of my hearers have been spending their lives in considering and teaching it, and are far better prepared to instruct me than I am to reciprocate. I would remind such that there is at last a large and growing number of people who are intensely interested in what the chemist has done and is doing and still more in what he will accomplish in the future. It is therefore rather to that public, many representatives of which are present to-night, than to the chemists in this gathering that I would address myself.

Research in the distant past was the privilege of the few. In chemistry, during the middle ages, the alchemists were practically the only ones pursuing it, and they in secret, and not always from the highest of motives. Working by themselves, as they did, they had not the great advantage of meeting and discussing with others similarly engaged, and using their progress and mistakes to intensify

[1] Address of the president of the American Chemical Society, Philadelphia, September 4, 1919.

their own increase in knowledge. Thus it has come about that the science of chemistry is little more than a century old, and its tremendous advances only a few decades. The first chemical society in the world was born in Philadelphia in 1793, and yet the real advances have been made since the formation of this society in 1876. Since that time, however, the advance in knowledge has been startling, not alone in this country, of course, but in all civilized countries. It is not boasting to say, however, that during all that time, the progress in this country has been in no wise behind that of the best anywhere, which our public is at last beginning to recognize. Particularly during the trying period of the war, when vast and new problems were suddenly thrust upon them, the work of our chemists has been beyond praise.

At the foundation of all this advance, research is firmly imbedded. Without it, the structure could not have risen, or the glowing anticipations of the future even imagined. Twenty centuries ago, we were told "Seek and ye shall find; knock and it shall be opened unto you." No one can deny that there have been accidental discoveries, some of great moment; but this has not been and will not be a safe dependence. Walking on the street one day, I picked up a roll of bills, whose owner curiously enough could not be found; but this did not lead me to give up my ordinary occupations, and wander around the streets of New York with the hope of further and continued good fortune of like character. Accidental discoveries are not to be relied on, of course, although they are not to be scorned. In chemistry the accidental good fortunes have usually come to those who were really seeking, although possibly for something far different, but, note this, they were usually made by men qualified to recognize an important discovery when it flashed across their vision.

Research, of course, is not of necessity to result in invention. It may in that respect terminate in a cul-de-sac from which with present knowledge there is no egress, or what more frequently happens, it may lead to a line of reasoning, which in time leads to another, and so on, until suddenly a bright light illumines the way, and a goal of the greatest possible importance is attained. Many instances illustrative of this will occur to you. I will cite only one, and that one because of the importance it has assumed in the light of recent developments.

As early as 1882 scientists rigidly established by chemical research what chemists call the "constitution" of the blue vegetable dye, indigo, and clinched that scientific conclusion by preparing the identical material in the laboratory. This particular important addition to human knowledge has remained a discovery merely; yet it so stimulated the search for practicable methods of applying that discovery to human needs that voluminous researches in a number of European countries were undertaken almost at once for that purpose. Of the host of scientific discoveries made as the direct result of chemical research in this direction, one was selected in 1897 as of such promise as to warrant the expectation that it would successfully displace vegetable indigo. Such was the ultimate fact. But, in 1901, others succeeded in devising a commercial mode of making indigo which was so formidable a rival to the mode adopted in 1897 that it seriously and at once threatened the supremacy of the latter, a thing which is now, some eighteen years later, actually coming to pass. It is worth while reflecting that the men who accomplished the scientific work of 1882 themselves never succeeded in making that work anything more than a discovery, despite the fact that for more than fifteen years they energetically tried to do so, and in their efforts they had the close cooperation of a large commercial organization. However, it remained for a college professor of chemistry in another country and himself working in quite a different field, and as a direct result of that work, to hit upon the central idea of the successful indigo mode of 1897 and to clinch it by appropriate laboratory methods. Yet his work remained for almost seven years a discovery only—a promising discovery to be sure—until the intensive work of others, overcoming many obstacles, made it serviceable to mankind. These two sets of workers were engaged in the same general class of chemical research, that

is, they were working in the organic division of chemistry. As you know, chemistry is serviceably, even though crudely, grouped under two grand divisions, organic and inorganic, and for many years these were treated quite separately from each other; I know "organic" chemists who look with mild indulgence upon the "inorganic" chemists and I also know inorganic chemists who return the compliment —with interest. In 1901, however, one of these so-called "inorganic" chemists, in searching for new worlds to conquer, hit upon an idea which he thought would make one of the discarded and discredited methods of making indigo a worthy rival of the only commercially successful indigo method of that day. And he was right! The owners of the 1897 method were forced to look to their laurels.

The history of the synthetic production of indigo is filled with many different discoveries of how indigo may be made in the laboratory, most of them wholly unrelated to the methods of 1882, 1897 and 1901. Two, at least, of them have made an unsuccessful and short-lived attempt to grow into an invention capable of meeting competitive conditions. Now, it is curious to note that the 1901 method was an offspring of the cyanide method of extracting gold which in turn is the gold-extraction method that made the South African gold fields so valuable. Immense amounts of that deadly poison, sodium cyanide, were needed in preparation for this gold extraction; that, in turn, called for unusually large amounts of other things and among these was that particular inorganic material that gave competitive ability in the world's markets to one of the theretofore discarded indigo methods. From the gold fields of South Africa to synthetic indigo is, indeed, a long cry. Is it, therefore, not wholly reasonable to expect that from some other equally far-off branch of chemical industry or of chemical research may come the proper stimulus to bring to active competitive life some of these other discarded indigo methods or even to create new methods superior to any we know of to-day? Among chemists we also distinguish physical chemists who are curious about subjects in that great twilight zone between the field of chemistry on the one hand and of physics on the other; also we have the electrochemist who is always searching for more or less direct chemical applications of the electric current. Just as the inorganic chemist in 1901 taught the organic chemist the secret of endowing a discarded indigo method with competitive life, may we not reasonably expect that some day the physical chemist and the electrochemist may, one or both, in the course of wholly unrelated chemical research work, come across facts which when intelligently applied to the indigo problem may still further advance it?

The chemical knowledge and research that enter into the synthetic production of indigo, as we know it to-day, come from over three generations of chemists, scattered all over the globe, speaking many languages, researching on many different and separate problems which touch almost every phase of human endeavor, and the end is not yet.

For centuries indigo has been the undisputed king among dyes. Chemists have made many attempts to displace it by other dyes, but it has so far successfully withstood all such attacks upon it—except as to its source or origin. Indigo is still the king, but its supremacy is threatened and threatened seriously and its undoing, if that should ensue, is traceable directly to itself. Chemists have long felt sure that the true reason for the supremacy of indigo lay in the manner in which it dyes fabric. It possesses the unique faculty of being, what you have all so often read of in the daily papers, a "vat" dye. It is the pioneer vat-dye and until comparatively recently it was the only vat-dye. Vain attempts to create or imitate this vat-dyeing property in other dyes are recorded by the score in the history of coal tar dyes. But, about twenty years ago, a real vat-dye was constructed in a research laboratory which ultimately turned out to have an entirely different constitution from indigo. This supplied the key to an entirely new class of dyes. Although among the multitudes of "vat" dyes constructed along these new lines many are wholly worthless, there are, nevertheless, a

goodly number of them having all the desired advantages of indigo and others equally numerous, possessing highly prized advantages which indigo lacks. All of these good ones are free from certain disadvantages of indigo and, what is more important, their shades cover every tint in the rainbow satisfactorily except the reds and those can not much longer elude the searchers. Some day a new blue dye may result from these researches or from other researches growing out of them and indigo will no longer be king. In still other directions the chemical study of indigo has been fruitful. By proceeding along lines similar to those of the 1897 method, but displacing the nitrogen by sulfur, an entirely new line of materials has been made accessible through chemical research and no man is wise enough to place the limit upon the directions and the extent that chemical ingenuity and research will ultimately go in this one very small field of chemical effort, which requires and draws upon all the sources of chemical knowledge we have. The possibilities seem limitless.

True research must be intentional and intensive. We must really seek if we would find. We must really knock at the doors of the secret chambers of knowledge, if they are to be opened to us. We must have imagination, it is true, but we must have more than that. There must be the foundation of sound education, and the ability to extend it to embrace new and unexpected knowledge, and apply this in turn as we progress upwards.

To fit a man for research in chemistry or any other science, many things must be accomplished before the candidate is ready to take his first advanced step. Many methods of procedure have been suggested, and some heat of argument generated; but all agree that education which produces real practical knowledge is absolutely essential. All agree, also, that the person to be prepared must be a likely subject; and that energy and time should not be wasted on those who do not show that they possess certain necessary qualifications. I think that it will also be generally admitted that the teacher himself should not only have great attainments, but must also possess the rare quality of being able to transmit knowledge in such a way that it will be truly absorbed by the pupil and form part of him. One of the greatest mathematicians I have ever known was about the poorest teacher. He knew but could not impart. The future of the world, therefore, depends in a very large degree, on the teacher in the school and on the professor in the college. They have an opportunity to mold the world, which many of them thoroughly appreciate. Alas, in most instances, the consciousness of work well done is about their only reward. Some day, and I hope not a very distant one, it will be generally recognized that, like other laborers, they are worthy of their hire, and their compensation will more nearly approximate the value of the work done. When that happy day arrives, they may experience a little less of the satisfaction of sacrifice, but they will have other comforts and hopes which will more than make this up to them and to their families. Like others before me, I advise the people of this country that they can make no better investment than one liberal enough to cause the teaching profession to attract not only those whose high sense of duty leads them to embrace it at a sacrifice, but also those who can not afford to make the sacrifice, however anxious they may be to do so. Men preparing for research must have the best men in the country to guide them, and it is not fair to expect these men, as so many have done in the past, to live the narrowing life of poverty. Neither is it wise.

There are a few foundations specifically provided for chemical research, such as the Warren Fund of the American Academy of Arts and Sciences, the C. M. Warren Fund of Harvard University, and the Wolcott Gibbs Fund of the National Academy of Sciences. There are a number of foundations for promoting research generally which have included chemical research within their fields, such as the Bache Fund of the National Academy of Sciences and the Elizabeth Thompson Science Fund. The Rockefeller Institute for Medical Research fosters chemical research contributory to its main object, the Carnegie Institution of Washington supports

chemical research in its general policy of advancing knowledge through research. The newest of all is the fund recently placed at the disposal of the National Research Council for stimulating chemical research. There is need for many more foundations if we are to keep pace with the rapid strides of civilization, or better still, to determine the direction they will take.

The importance of research is being more and more recognized and understood by the public. One of the most encouraging evidences of this is shown in the preamble and resolution adopted recently by the American Federation of Labor at Atlantic City, indicating, as these do, a clear appreciation by that great association of how much we all depend on what science will disclose to ameliorate the conditions of the future. It is well worth while to read these in full here. They are as follows:

WHEREAS, scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining and others must rest; and

WHEREAS, the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

WHEREAS, the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase since there is a limit beyond which the average standard of living of the whole population can not progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry; and

WHEREAS, there are numerous important and pressing problems of administration and regulation now faced by federal, state and local governments, the wise solution of which depends upon scientific and technical research; and

WHEREAS, the war has brought home to all the nations engaged in the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertaking are already active; therefore be it

Resolved, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the federal government, and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of the federation is instructed to transmit copies of this resolution to the President of the United States, to the president pro tempore of the Senate, and to the Speaker of the House of Representatives.

I hope and believe that this matter coming as it does from a new direction will be most seriously considered by the proper authorities —not that it has not already been well understood in Washington, but that renewed interest may be taken and even more liberal appropriations granted. The federation resolution urges that "a broad program of scientific and technical research is of major importance to the national welfare." Good! Now that everybody is agreed, how was it possible that for so long a time this belief was held by so few, and these composed almost entirely of men of science? The question, therefore, is squarely before the country, and the urgency of it thoroughly appreciated by those who have the most to gain by it; namely, the workers on whose efficiency so much depends. Now this opens the way to a scientific solution of vital questions about which there has been such fundamental differences of opinion, based largely on what may be called the point of view. People have divided themselves into classes—a very dangerous course—and many —a very great many—have actually believed that there must of necessity be a deeply rooted

difference between capital and labor, and that the true interests of either were entirely apart from those of the other. Many have held that labor is a commodity which it was to their best interest to get the most of for the least money, while many others believed that labor was the sole source of all wealth, and that the fewer hours worked, and the smaller the output of those hours, the better it would be, somehow or another, for the laboring classes. I have cited the extreme views for purpose of illustration, realizing the somewhere between the two would be found the great body of all reasonable and thoughtful men. We may leave out of consideration here that ultra-extreme class who teach, whether they believe it or not, that the true interests of labor would be best served by sabotage and syndicalism, and all the other fantastic notions which have of late years been more or less in evidence, and liable to catch the unwary. To these, research presents no attractions.

Now I am going to venture to suggest to the working man who is earnestly desirous of bettering his own and his family's condition, that there are a good many sciences besides chemistry and the engineering and abstract sciences in general. Some of these he is better able to study and practise than any one else. Many of the fundamental truths concerning labor and its conditions would never be discovered by the scientist per se, because he has not had the benefit of practical preparation. Let our friends of the American Federation of Labor not be content with what the government can do in the line of their resolution, good as it has been and will be, but let them start a carefully planned series of researches themselves, and follow them up until the truth stands revealed. They can depend upon the assistance of this great society. The employers of labor have been doing this for years, singly and in groups, seeking the same end. The shining goal of all research is the truth, the whole truth, and nothing but the truth. Thus, starting from different angles, with fairness and thoroughness, the various so-called interests will arrive at the same truth, for there can only be one truth concerning any question. Thus will it come to pass that capital and labor will discover that the true interest of one is the true interest of all, and instead of bickerings and suspicions we will have that cordial cooperation which is absolutely essential if we could get the best out of this good old world of ours.

Scientific discovery is really not a haphazard matter. The art of making it can be cultivated, and definite rules of research can be laid down. Many elements enter into the problem and these have been very well tabulated by the late Dr. Gore, F.R.S., in his book, "The Art of Scientific Discovery." While the list he gives may not be complete, it is so nearly so that it is well worth quoting here. His table is as follows:

1. Aid to analogy.
2. Hypotheses.
3. Analysis and synthesis.
4. Application of (*a*) electricity to bodies; (*b*) heat to substances.
5. Asking questions and testing such questions.
6. Assumptions that—
   (*a*) There is certainty of all the great principles of science.
   (*b*) Complete homologous series exist.
   (*c*) Converse principles of action exist.
   (*d*) Certain general statements which are true of one force or substance are true to some extent of others.
7. Combined action of many observers.
8. Comparison of—
   (*a*) Facts, and collecting similar ones.
   (*b*) Collections of facts with each other
   (*c*) Facts with hypotheses.
   (*c*) The orders of collections of facts.
   (*d*) Facts with hypotheses.
9. Deducting process.
10. Employment of new or improved means of observation.
11. Examination of—
    (*a*) Common but neglected substances.
    (*b*) Effects of forces on substances.
    (*c*) Effects of contact on substances.
    (*d*) Effects of extreme degrees of force.
    (*e*) Extreme or conspicuous instances.
    (*f*) Influence of time upon phenomena.
    (*g*) Neglected truths and hypotheses.
    (*h*) Peculiar minerals.
    (*i*) Unexpected truths.
    (*j*) Rare substances.
    (*k*) Residue phenomena.

(*l*) Residues of manufacture.
(*m*) The ashes of rare plants and animals.

12. Extension of—
(*a*) The researches of others.
(*b*) The researches of neglected parts of science.
13. Inductive process.
14. Investigations of—
(*a*) Exceptional cases.
(*b*) Unexplained phenomena.
(*c*) Classification unexplained.
15. Means of—
(*a*) Converse experiments.
(*b*) Hypotheses.
(*c*) Homologous series.
(*d*) Instruments of great power.
(*e*) Improved methods of intellectual operation.
(*f*) Measurements.
(*g*) The method of curves.
(*h*) The method of least squares.
(*i*) The method of means.
(*j*) The method of residues.
(*k*) New instruments.
(*l*) Modes of observation.
(*m*) Observations.
(*n*) More intelligent and acute observation.
(*o*) Additional observations by known methods.
(*p*) Periodic functions.
(*q*) More refined methods of working.
(*r*) Repetition of experiments.
16. Simple comparisons of facts of phenomena.
17. Search for—
(*a*) So-called "impossible" things.
(*b*) One thing and finding another.
18. Subjecting series of forces or substances to new conditions.
19. Use of—
(*a*) Known instruments or forces in a new way.
(*b*) Improved instruments.
(*c*) More powerful instruments.
(*d*) Causes by the methods of averages.
(*e*) Coincidences.
20. Conditions of—
(*a*) Scientific discovery.
(*b*) Determination of the nature of a discovery contrasted with barren reasoning.
21. Dependence of discovery upon art of exceptional instances.
22. Fundamental laws of discovery.

Research does not always lead to discovery, nor discovery to invention, but the sequence is logical. Gore defines the difference between discovery and invention in these words: "Discovery consists in finding new truths of nature, whilst invention consists in applying those truths to some desired purpose;" and that definition is sufficiently accurate. The natural application of research is therefore invention. How can this application and its corollaries best be carried out?

The concrete application of a truth is of course necessary for its widest usefulness. There are various theories as to the best way of accomplishing this. Take our old friend Wackford Squeers for instance—a highly interesting character in one of Dickens's best books:

> This is the first class in English spelling and philosophy, Nickleby. Now then, where's the first boy?
>
> Please, sir, he's cleaning the back parlour window, said the temporary head of the philosophical class.
>
> So he is, to be sure, rejoined Squeers. We go upon the practical mode of teaching, Nickleby; the regular educational system. C-l-e-a-n, clean; verb, active, to make bright, to scour. W-i-n, win, d-e-r, der, winder, a casement. When the boy knows this out of a book, he goes and does it. It's just the same principle as the rule of globes. Where's the second boy?
>
> Please, sir, he's weeding the garden, replied a small voice.
>
> To be sure, said Squeers, by no means disconcerted. So he is. B-o-t, bot, t-i-n, tin, bottin, n-e-y, ney, bottiney; noun, substantive; when he has learned that bottiney means a knowledge of plants, he goes and knows 'em. That's our system, Nickleby; what do you think of it?

During the intense pressure of recent years, this Squeers system has had a good trial, and seems to have left more or less to be desired. The taxpayer knows the sequel, and will be reminded of it from time to time for the rest of his life.

The application of research has always required a high order of talent. In the future, a still higher order of talent will be necessary, but in addition this talent must be prepared

by education to do this very thing. Sir Robert Hadfield, F.R.S., has said, after England had been struggling with belated preparation for nearly two years:

Until quite recently many mistakes were made, either because the scientific man had been installed in view of his special knowledge, or, at the other end of the scale, the practical man was given the preference. In a general way neither of these types has been a success.

Admitting Sir Robert's conclusion, how can we produce the leaders who shall adequately combine both qualifications? That is one of the greatest and most interesting problems awaiting solution by our educators, and on its correct solution depends in a larger degree than many imagine, the future of successful and contented industry in this country. I shall not attempt in the presence of so many educators of acknowledged ability, to show the way, even if I felt persuaded that I knew it, as the matter is of too great consequence to run the risk of an amateur indicating the wrong road. I shall content myself by pointing out the need, with the hope of turning the attention of the great public to its existence. In our free country, the people generally get what they really want, and it is worth while to lead them to want the greater things, and not to be satisfied with the lesser.

There are certain fundamentals, however, that all will agree to, if it be true that the leaders of the future will have far greater problems to solve than have yet been conceived.

1. The candidate for leadership should have a healthy body. Great things have been accomplished by men and women of fragile physique, but they would have accomplished greater if they had not been thus handicapped.

2. He should have good habits, which involves good character. This is vital if we would have leaders who would be a blessing and not a curse. We can easily call to mind men of splendid health and intellect who used these gifts to the injury of their fellows, and not to their advantage. Do not waste time or energy in educating for leadership a man of bad or doubtful character or whose aims are selfish.

3. Of course he should have a good mind, educated to the highest degree attainable. This education should be specialized in the desired direction, while good all around. No really great leader can be lop-sided if he would avoid being a "crank."

4. He should have a thorough knowledge of human nature. To play on the "harp of a thousand strings" requires on unusual acquaintance with the instrument. How many men otherwise great have broken down here, sometimes because they have given too much confidence, sometimes not enough, sometimes because they did not know how to select assistants. The knowledge of human nature is a great gift in itself, which can be acquired and increased. It lies at the foundation of wisdom, which King Solomon pronounced the "principal thing."

With the qualifications enumerated and others which will occur to you, the candidate for leadership is well equipped. To direct him to full fruition is a noble task. Let us proceed to fill our high places of every kind with the men and women specifically prepared to fill them, being assured that the effort to do so will produce an army of those not quite qualified for the top, but of the greatest value to assist those who are, and who without such aid would resemble "faith without works," we are told, is "dead being alone."

Research leads to discovery, discovery to invention, invention—no one knows where. Applied and supervised by those prepared for the task, the strides of progress will be long, and the benefit to the human race in proportion. Let us educate for living—certainly—but let us also educate for leadership—that superlative leadership of which civilization will stand more and more in need, as it increases in complexity, and reaches higher and higher planes.

WM. H. NICHOLS

THE INTERALLIED CHEMICAL CONFERENCE[1]

THE delegates of the Federated Chemical Societies of America, Belgium, England, France and Italy met in London, July 14 to

[1] Based on advance sheets from *Journal of Industrial and Engineering Chemistry*.

17, 1919. The United States was represented as follows: Dr. F. G. Cottrell, chief metallurgist, U. S. Bureau of Mines; Dr. C. L. Parsons, chief chemist, U. S. Bureau of Mines, secretary of the American Chemical Society; Dr. E. W. Washburn, professor of ceramic chemistry at the University of Illinois, past chairman of the division of chemistry and chemical technology of the National Research Council.

The proceedings of the conference were conducted in French, M. Moureu acting as chairman and M. Gérard as secretary. Almost the whole time was taken up in framing the constitution of the new body, which is to be known as the "International Union of Pure and Applied Chemistry," and in discussing the desirability of its inclusion in the scheme of organization projected by the Conference on Scientific Academies. The following officers were elected for a term of three years: *President,* M. Moureu; *Vice-presidents,* M. Chavanne (Belgium), Signor L. Parodi Defino, Dr. C. L. Parsons and Sir William Pope; *General Secretary,* M. Jean Gérard, 49 rue des Mathurins, Paris.

In addition to the five countries represented at this meeting, it was agreed that the British Dominions and the nations signatory to the Peace Treaty should each have separate representatives on making application. In this connection Canada and Poland have already signified their adhesion. It was also decided to admit neutral countries. With the exception of Belgium, each of the nations at present represented in the International Chemical Union has formed a national organization similar to the British Federal Council for Pure and Applied Chemistry; thus the United States has instituted a Chemical Division of the National Research Council; France, the Fédération Nationale des Associations de Chimie Pure et Appliquée; Italy, the Associazone Italiana di Chimica Generale ed Applicata.

The following resolutions were passed:

The International Union of Pure and Applied Chemistry, meeting in conference in London from July 14 to 18, 1919, hereby records the following opinions:

1. That the Confederation should be included in the scheme of organization contemplated by the Conference of Scientific Academies, with autonomous powers, as the Chemical Section of the International Research Council.

2. That it shall constitute "The International Committee of Chemistry."

3. That the various international delegates representing chemistry at the meeting of the International Research Council shall be appointed by the same National Federation which appoints the delegates to the Confederation.

4. That the officers of the present Confederation be, *ex officio* officers of the Chemical Section of the International Research Council.

It was decided to hold the next meeting of the International Chemical Union in Italy during the first two weeks of June, 1920.

The conference adjourned to meet again in Brussels on July 22 in connection with the International Research Council. The American delegates were joined by Dr. H. S. Washington. Professor Albin Haller joined the French delegation and presided over the meeting.

The meeting at Brussels was largely engaged in the discussion, modification and final adoption of the statutes of the new International Union of Pure and Applied Chemistry. It was informally agreed that the only apparent basis for international cooperation on the abstracting of chemical literature was a simple exchange of proof sheets of abstracts between the various countries interested, although it was thought possible that the Latin countries might be able to combine to advantage in publishing an abstract journal in French. Also it was informally agreed that America should go ahead with her proposed program on Scientific and Technical Monographs, the issuance of these to be later correlated, if possible, with the English program on Compendia of Organic and Inorganic Chemistry should their plans at first proposed be extensively modified.

The election of officers as made in London was confirmed and the International Union of Pure and Applied Chemistry became officially the chemical section of the International Research Council.

THE BRUSSELS MEETING OF THE INTERNATIONAL RESEARCH COUNCIL

A FEDERATION of National Research Councils met in Brussels on July 18–28. From an article in *Nature* we learn that the following countries and dominions were represented by their delegates: Belgium, Canada, France, Italy, Japan, New Zealand, Poland, Roumania, Serbia, the United Kingdom and the United States of America.

On the morning of July 18, the delegates met in the Palais des Académies, where King Albert was present. M. Harmignie, the minister of science and arts, welcomed them in a short address in which he dwelt on the importance of the occasion and on the valuable results which would be obtained from international cooperation in science, and wished them success in their deliberations.

M. E. Picard, the president of the executive committee, was prevented by ill health from being present, M. A. Lacroix presided at the meetings of the general assembly. The first business was the consideration of the statutes of the International Research Council which had been provisionally agreed upon in Paris, and now came up for consideration in the final form as recommended by the executive committee.

The objects of the council are therein defined to be:

(*a*) To coordinate international efforts in the different branches of science and its applications.

(*b*) To initiate the formation of international associations or unions deemed to be useful to the progress of science.

(*c*) To direct international scientific action in subjects which do not fall within the province of any existing association.

(*d*) To enter, through the proper channels, into relations with the governments of the countries adhering to the council to recommend the study of questions falling within the competence of the council.

The countries adhering to the council are those already mentioned as represented by their delegates as well as Brazil, Australia, South Africa, Greece and Portugal—that is, those of the allied nations who were originally invited to form the International Council as possessing academies of science, and being engaged in scientific work. To these, other nations may be added at their own request or on the proposal of a country already belonging to the council, or union, by a three-fourths vote in favor of admission.

The work of the council will be directed by the general assembly, which will meet ordinarily every three years, but in the interval between its successive meetings business will be transacted by an executive committee of five members nominated by the general assembly and holding office until the next meeting of the general assembly. In the present case the executive committee, consisting of Professor E. Picard, Dr. A. Schuster, Dr. G. E. Hale, M. Volterra and M. Lecointe, has been reelected and will consider its character and constitution and report to the next meeting of the general assembly before its organization is finally laid down.

The concluding meeting of the council was held on July 28, when it was decided that all neutral nations should be invited to join the International Research Council and the International Unions created under its auspices, thus providing for the reconstitution of international scientific associations so far as is practicable at the present time.

SCIENTIFIC EVENTS

THE GALTON LABORATORY

IN a letter to the London *Times* Professor Karl Pearson calls attention to the fact that in 1908 Sir Francis Galton died and left the residue of his estate to the University of London for the maintenance of a laboratory for the study of eugenics. The objects of that laboratory were to be: (1) Research concerning all that tends mentally or physically to the improvement of the race; (2) dissemination of the knowledge thus acquired by public lectures and publications; and (3) the accumulation of material bearing on problems of racial fitness. Owing to the generosity of Sir Herbert Bartlett, a building for the housing

of the Drapers' Biometric Laboratory and the Galton Eugenics Laboratory was completed in 1914. This building contains a public lecture theater, a public museum and library, archive and instrument rooms, anthropometric laboratories and investigation rooms, besides full provision for laboratory and class teaching, with private rooms for research workers. The building was used for war purposes and money is now needed to complete its equipment. Professor Pearson writes:

The Biometric and the Galton Laboratories were the first of their kind to be established; they no longer stand alone. The United States have their professors of biometry and their eugenics laboratories backed by funds which we can not hope to rival. Why is it that Britain so often starts the new idea, but leaves it to fructify in other lands? Especially important is at the present moment the field of activity for our science. The war has brought many problems to the fore; eugenical research has much ground to make up, and most serious questions as to national efficiency are demanding scientific treatment. The Galton Laboratory is in every respect in a worse position in 1919 than it was in 1914; its staff has to undertake far heavier and more urgent work than it then dreamt of; its buildings can not be properly equipped; its publication funds, slender in 1914, can not now encompass a third of what was possible at that date, for the price of printing, binding and publication is now nearly threefold; memoirs awaiting publication can not be issued. And, lastly, the highly-trained staff, largely absorbed into national work during the past five years, can not be reestablished on the old basis, for the old scale of payment has ceased to provide a living wage. The war has in many cases crippled institutions as well as men. Are we to see the scheme of one of the most suggestive and inspiring men of modern times and a science wholly British in its inception reduced to infruition because the university and the Galton Laboratory staff did what lay in their power to aid the national cause in a time of grave pressure?

THE POTATO DISEASE CONFERENCE

On June twenty-fifth to twenty-eighth the advisory board of American Plant Pathologists held a Potato Disease Conference on Long Island at which nearly one hundred persons chiefly interested in plant disease attended. Meetings were held at Riverhead and Watermill, Long Island and at the Hotel McAlpin, New York City.

Three automobile excursions were taken through the island. On Wedneslay, June 25, a tour was made of the north side where several most interesting field experiments were inspected. These experiments were conducted under the direction of representatives from the New York State College of Agriculture, the Suffolk County Farm Bureau, The Bureau of Plant Industry, United States Department of Agriculture, representatives from Canada and Bermuda, and the Geneva Agricultural Experiment Station.

On Thursday a trip was taken to the south side, where further experiments were inspected. During the afternoon, a meeting was held at Watermill, where addresses were made by Dr. A. D. Cotton, of the Board of Agriculture, England, who spoke on the development of plant pathology in England; by Dr. George H. Pethybridge, of the Board of Agriculture, Ireland, who gave a history of the phytopathological work in Ireland; by Dr. H. M. Quanjer, of the Pathological Laboratories, Wageningen, Holland, who gave a résumé of his researches on leaf-roll and mosaic of potato; and by Dr. H. A. Edson, of the Office of Cotton, Truck and Forage Crops Disease Investigations, Bureau of Plant Industry, who read a paper by Schultz, Folson, Hildebrandt and Hawkins on "The Mosaic Disease of the Irish Potato."

On Friday, a tour of Nassau county was enjoyed by those attending the conference. Among the places of especial interest visited on this trip were the field laboratory of the New York State College of Agriculture, at Greenlawn, the Pratt Estate, at Glen Cove and Sagamore Hill, the home of the late Colonel Roosevelt. A special visit was also made to Colonel Roosevelt's grave.

On Saturday, about forty met at the Brooklyn Botanic Garden for a conference of the North East Pathologists on general plant diseases. At this meeting they were addressed by Dr. H. M. Quznjer, who gave an illustrated

lecture on potato leaf-roll. A short discussion was held upon some apple and tomato diseases.

The arrangements for this conference were in the hands of a committee under the chairmanship of Dr. M. F. Barrus, of Cornell University. The other members of the committee were: Messrs. H. H. Whetzel, of Cornell University; P. A. Murphy of Canada; E. J. Wortley, of Bermuda; W. A. Orton, of the Bureau of Plant Industry, and C. R. Orton, of the Pennsylvania State College.

MR. CARNEGIE'S WILL

THE will of the late Andrew Carnegie was filed on August 28. A statement issued by Elihu Root, Jr., says:

> Mr. Carnegie's gifts to charity during his lifetime totalled somewhat in excess of $350,000,000. The value of his estate is estimated at between $25,000,000 and $30,000,000. He really did divest himself of his great fortune for the benefit of mankind, as he long ago said that he would.
>
> The will leaves the real estate and all the works of art and household goods to Mrs. Carnegie. Financial provision for Mrs. Carnegie and for Mrs. Carnegie's daughter, Mrs. Miller, was made during Mr. Carnegie's lifetime rather than by will.
>
> The fourth article of the will contains a series of legacies, the most substantial of which are to charitable institutions. The fifth article of the will contains a series of annuities to relatives and friends. The Carnegie Corporation of New York is the residuary legatee, and Home Trust Company of New Jersey is the executor and trustee under the will.

The public bequests include: To the Cooper Union, $60,000; to the University of Pittsburgh, $200,000; to Hampton Institute, $300,000, and to Stevens Institute, $100,000.

The annuities include $10,000 to Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching and $5,000 to Dr. Robert S. Woodward, president of the Carnegie Institution of Washington, and Dr. W. J. Holland, director of the Carnegie Museum at Pittsburgh.

SCIENTIFIC NOTES AND NEWS

MAJOR LAWRENCE MARTIN, General Staff, U. S. Army, who is chief, Geographical Section, Military Intelligence, U. S. Army, left Paris on August 17 for Turkish Armenia, Russian Transcaucasia and Persia, as geographer to General Harbord's Mission to Armenia.

WITH the approval of President Wilson, Dr. Charles H. Herty has sailed for France to obtain for dye consumers of this country a six months' supply of such dyes as are now needed but have not yet been manufactured here. The dyes include the so-called "vat colors," which are used chiefly by the manufacturers of wash goods. It is expected they will be shipped to this country within sixty days.

MAJOR F. E. BREITHUT, formerly of the Chemical Warfare Service Division of the United States Army, also assistant professor of chemistry at the College of the City of New York, has resigned to accept a position with The Foundation Oven Corporation.

MR. FREDERICK L. HOFFMAN, vice-president and statistician of the Prudential Insurance Company, has gone to England to make an intensive investigation into the effects of war on insurance, including the methods and results of national health insurance in Great Britain.

DR. ROLLIN T. CHAMBERLIN and Mr. Ben Herzberg are spending the summer in Alaska and northwestern Canada. The working season down to the early part of August was spent in special lines of investigation on particular phases of the mechanics of glacier movement in western Alaska and the remainder of the season down to the middle of September will be given to field work on the evidences of diastrophism in the northern Rockies.

PROFESSOR W. B. HERMS, associate professor of parasitology in the University of California, and a party of assistants, have completed a malaria-mosquito survey of California during the past summer and the former has resumed his university work. The survey was

begun early in 1916 and carried through the summer of 1917, but, owing to Professor Herms's absence while serving with the United States Army, the work was held in abeyance until the opening of this year. The greater part of the summer's work was carried on in the San Joaquin Valley, however, several weeks were spent in the mountainous countries of Alpine, Mono and Inyo and in portions of San Bernardino. The highest elevation reached was approximately ten thousand feet and the highest elevation at which Anopheline mosquitoes (*Anopheles quadrimaculatus*) were encountered at any time during the survey was 5,482 feet. A total of 18,088 miles were covered in the survey, all by automobile. A report of the survey in the northern third of the state has already been published (U. S. Public Health Report, July 18, 1919) and other reports will be issued in due time. The survey was conducted under the joint auspices of the California State Board of Health and the University of California.

DR. STUART WELLER, professor of paleontologic geology at the University of Chicago, succeeds the late Samuel Wendell Williston as director of the Walker Museum.

DURING summer quarter at the Yerkes Observatory of the University of Chicago, Paul Beifold, professor of astronomy and director of Swasey Observatory, Denison University, acted as voluntary assistant; Francis P. Leavenworth, professor of astronomy and director of the observatory at the University of Minnesota, as visiting professor, and Clifford C. Crump, professor of astronomy and director of the Perkins Observatory, at Ohio Wesleyan University, as volunteer research assistant.

MR. JULIAN S. HUXLEY, a scholar of Balliol College, Oxford, from 1905 to 1909, and from 1913 to 1916 associate professor of biology in the Rice Institute, Houston, Texas, has been elected a fellow of New College.

UNIVERSITY AND EDUCATIONAL NEWS

THE board of trustees of the University of Tennessee is planning to erect a building for the medical department of the university at Memphis, to cost $100,000.

AT the University of Arkansas Dr. John T. Buchholz, formerly of the West Texas Normal College, has been appointed head of the department of botany, and G. P. Stocker, formerly professor of civil engineering in the Agricultural and Mechanical College of Mississippi, head of the department of civil engineering.

B. L. RICHARDS, Ph.D. (Wisconsin), has been appointed associate professor of botany at the Utah Agricultural College and Experiment Station.

MR. W. H. TIMBIE, author of books on electrical engineering and applied electricity, has been appointed associate professor of electrical engineering in the Massachusetts Institute of Technology.

DR. ALPHONSE RAYMOND DOCHEZ, of the Rockefeller Institute for Medical Research, has been appointed associate professor of medicine at the Johns Hopkins University.

PROFESSOR ANDREW HUNTER has been appointed to the chair of biochemistry in the University of Toronto, vacant through the resignation of Professor Brailsford Robertson.

DR. S. CHAPMAN, chief assistant at Greenwich Observatory, has been appointed professor of mathematics in the University of Manchester.

DISCUSSION AND CORRESPONDENCE

DIRECT PHOTOGRAPHY OF COLONIES OF BACTERIA

IN view of the desirability at times of obtaining photographic record of Petri dishes which have been inoculated with bacteria and incubated, the following extremely simple and rapid method may prove useful.

The special value of this method from the pedagogical point of view is its simplicity, no camera, plates, or dark room being necessary. This makes it possible for all members of a class to preserve accurate and permanent records in comparing bacterial counts in samples of water or milk, to show form of growth on Petri dishes, to illustrate the

colonies arising from the tracks of flies walking across the gelatine, etc.

The method consists of placing the uncovered Petri dish against photographic paper in a dark corner of the laboratory, bringing forward into the light, and returning to a dark corner for development and fixing. I have had very good results by using Azo hard X exposed to a medium light for five seconds. Good results can also be obtained by using blue-print paper exposed to bright sunlight for forty-five seconds. This paper requires less care in handling in the light and only water for fixing but must be fastened to the Petri dish by spring clip or gummed label to prevent moving during the long exposure.

The result of this direct photography is a positive; that is the white bacterial colonies on the Petri dish appear white on the print; not black as they would on a negative. Careful comparison of the direct prints with ordinary photographs made from a negative shows no loss by the shorter method.

A. A. COPE

SHELL-SHOCK IN THE BATTLE OF MARATHON

TO THE EDITOR OF SCIENCE: Herodotus, describing the battle of Marathon, 490 B.C. (Book VI., section 117), says:

> The following prodigy occurred there: an Athenian, Epizelus, son of Cuphagoras, while fighting in the medley, and behaving valiantly, was deprived of sight, though wounded in no part of his body, nor struck from a distance; and he continued to be blind from that time for the remainder of his life. I have heard that he used to give the following account of his loss. He thought that a large heavy-armed man stood before him, whose beard shaded the whole of his shield; that this specter passed by him, and killed the man that stood by his side. Such is the account I have been informed Epizelus used to give.

Is this, perchance, the first account of "shell-shock"?

DEAN A. WORCESTER

THE AURORA OF AUGUST 11 AT BURLINGTON, VERMONT

ON August 11, at approximately 10 P.M. (E'n "Summer" Time), the aurora borealis, as seen in Burlington, Vt., appeared as follows: On a cloudless night with a nearly full moon, and east-west band of light, from horizon to horizon, increased in brightness as each end broadened northward. The zenith became brilliant violet, an inverted bowl of shifting color. Practically the whole sky was bright: and especially just above the northern horizon intensely white rays shot up toward the zenith. Near the violet center, pale pink and green occasionally showed. The lights lasted for several minutes, lingering longest near the northern skyline.

JEAN DICKINSON

WILL THERE BE ANOTHER AURORA ABOUT SEPTEMBER 7-8, 1919?

THE intensity of the magnetic storm and the brilliance of the aurora of August 11–12 would indicate a disturbed region on the sun, the next presentation of which, opposite the earth about September 7–8, may produce another aurora. Such was the case April 4–6, 1918, following the brilliant aurora of March 7–8.

CHARLES F. BROOKS

QUOTATIONS

LABOR AND SCIENCE

ARE the great industrial countries moving in a vicious circle? The manifesto of the American Federation of Labor, which we publish [reprinted from SCIENCE] in another column, takes this view, and moreover, suggests a remedy. There is an "ever-increasing struggle of the workers to raise the standard of their living." Hitherto this has implied increased wages and shorter hours, or less production at higher cost. But now the "limit has been reached after which the average standard of living can not progress by the usual means of adjustment," by which are meant strikes, politicians' promises and public subsidies. If bankruptcy, moral and financial, is not to ensue, production, says the manifesto, must be increased by research and by the utilization in industry of the results of research. The vital necessity of scientific methods is clearly and cogently stated. In an age of steel and telegraphy, of aseptic surgery and of preventive medicine, of Mendelian breeding

and of tanks and poison gas, science is accepted as a paying proposition; but it is still too often looked on as a consultant to be called in special cases, or as a piecework artisan to be paid by the job. The manifesto proclaims a wider and a truer view. It distinguishes between "scientific" and "technical" research—that is to say, between disinterested and utilitarian explorations of nature. The former are demanded by those who know history; the latter mesmerize the bureaucracy. Labor demands a program of research in both senses; it declares the value of the advancement of knowledge to be many times greater than its cost; and it insists that many urgent problems can find wise solution only through scientific and technical research.—London *Times*.

SCIENTIFIC BOOKS

The Schrammen Collection of Cretaceous Silicispongiæ in the American Museum of Natural History. By Marjorie O'Connell, Ph.D. *Bulletin of the American Museum of Natural History,* Vol. XLI., Art. I., pp. 1–261, Plates I–XIV., Map and five text figures. Aug. 1, 1919.

In 1914 the American Museum purchased a collection of 800 specimens of fossil Silicispongiæ, comprising 116 genera and 222 species, and purporting to be types (Belegestücke) used by Dr. Anton Schrammen of Hildesheim in the preparation of his important monograph on the Cretaceous Silicispongiæ of northwest Germany. This material was entrusted to Dr. O'Connell for arrangement in the exhibition hall of the museum, in the course of which work she undertook a careful comparison of each specimen with the descriptions and illustrations in Schrammen's monograph. This led to the discovery that the term "Belegestück" was used in a very loose sense for material representing not only the true types, but also all material collected from type localities, and so included supplementary types (apotypes) as well as typical specimens (icotypes), the total of 358 types including only 86 primary types (with only 5 holotypes). This led Dr. O'Connell to a careful evaluation of the standing of each one of these specimens, which proceeding has greatly enhanced the value of the collection. But beyond this, Dr. O'Connell has gone most thoroughly into the synonymies of the genera and species, Schrammen's work in this respect being misleadingly incomplete, and so she has produced a distinct contribution to the literature of the Silicispongiæ, and supplemented Schrammen's monograph in a manner for which students of these organisms owe her thanks. This constitutes the major part of the work before us, being Chapter IV., and comprising pp. 97–207 of the *Bulletin*.

The first 97 pages of the bulletin however, are of broader scope, and will be of general interest, not only to students of paleontology but to those of stratigraphy as well. The introduction deals with the classification of the sponges and makes the latest classification by Broili (Zittel Grundzüge, 1915), and Schrammen available to American students. Chapter I. (pp. 8–30) gives a review of the development of the science of spongiology, dealing first with the investigations on recent, and then with those on fossil species. The history of investigation on recent forms is divided into five periods: (1) From the days of Aristotle to the seventeenth century; (2) period of determination of systematic position (1600–1750); (3) period of anatomical discoveries and classification (1750–1825); (4) period of detailed microscopic studies (1825–1874), and (5) period of modern investigations (1875–present), which opens with the first paper published by F. E. Schulze. The history of palæospongiology is thus summarized by Dr. O'Connell:

> In going through the literature on fossil sponges, one is struck with the close parallelism in the development of thought in the study of fossil and recent forms but one sees epitomized in the paleontological literature of two hundred years what is spread over two thousand years in zoological literature. The besetting difficulty for both groups of investigators was the determination of the best method of work, and, until this was discovered, all classifications were unsatisfactory and often artificial.

Classification on the basis of form has now given way to classification on the basis of the skeletal elements, a method adopted for recent sponges by Schulze in 1875, and for fossil forms by Zittel in 1876.

In this chapter Dr. O'Connell gives a review of the work done on fossil sponges to date in Great Britain, France, Russia, Bohemia and Germany. Based upon the summaries given by Rauff (Palæontographica, 1893-94) the author has brought the review up to date, and given us moreover a critical evaluation of all the important works which she has been able to examine personally, so that the student, especially the one not conversant with German, will find this the most satisfactory general historical summary in print. It is true that a few important papers have been overlooked, among them Siemiradski's monograph, "Die Spongien der Polnischen Juraformation" ("Beiträge zur Palæontologie und Geologie Osterreich-Ungarns und des Orients," Bd. XXVI., pp. 163–211, 1913, and in the Polish language in the publications of the Scientific Society of Warsaw for the same year), in which 92 species including a number of new ones are described according to modern methods, and illustrated on six quarto pages, and Vinassa P. de Regny's "Trias-Spongien aus dem Bakony" ("Resultate der wissenschaftlichen Erforschung des Balatonsees," Bd. I., 1901) and "Neue Schwämme, Tabulaten und Hydrozoen aus dem Bakony" (*ibid.*, 1908), but as the author's work was primarily with the Cretaceous sponges, such an oversight is not to be wondered at.

Chapter II. deals with the morphological characters of the Silicispongiæ, and this chapter is of value because it gives to the student the only comprehensive account of the characters and classification of the skeletal elements to be found in the English language not excepting that of Hinde. It is a more systematic presentation, because arranged chiefly in tabular form, than the elaborate one given by Rauff, and on that account will be found more serviceable to the general student. It is also more complete than that of Rauff, because it includes a number of new types introduced by Schrammen, and renders moreover into English a number of terms so far only used in German literature. This chapter is illustrated by 14 plates of outline drawings, selected from the illustrations given by Rauff and Schrammen. By an oversight these are all credited to Schrammen on page 34, though 48 out of the total of 71 are from Rauff, as correctly given in the description of plates. Plates I.–V. give an illustration for each type of spicule, while on Plates VI.–XIV. are given illustrations of the actual spicules of the species represented in the American Museum collection. The relationships of the many special types of spicules to, and their derivation from the three fundamental types the triod, tetraxon and the triaxon are also clearly set forth. In the discussion of the microscleres, reference should have been made to the important, though preliminary paper by P. Ortman, "Die Mikroscleren der Kieselspongien in Schwammgesteinen der Senonen Kreide" ("Neues Jahrbuch für Mineralogie," etc., 1912. Bd. II., pp. 127–149).

Chapter III. presents in 50 pages a summary of the stratigraphy of the Upper Cretaceous formations of Europe, and is in many respects the most valuable part of the work. Here the student will find what is probably the best general summary of this subject in the English language and the reviewer would recommend the perusal of this chapter to all students of European stratigraphy. It is not merely a summary of text-book literature, but is evidently based on a study of the original works, and reveals the author's grasp of the fundamental principles of stratigraphy. The study of the Cretaceous stratigraphy of Europe was undertaken by Miss O'Connell, as she tells us in the preface, as a part of the research work under the Sarah Berliner Research Fellowship for Women which she held for the year 1917–1918, and which was a study of the "Habitat of the Silicispongiæ." In this discussion of the stratigraphy the field is divided into eleven provinces, the disconnected character of which is primarily the result of post-Cretaceous erosion, which in many areas has removed the transitional facies of the

sediments, so that there is often a decided lithic and faunal distinction between the deposits of the several provinces.

In the British province the chalk shows a transgressive character from the southeast towards the northwest, and generally begins with a basal clastic series which rests upon the eroded surface of various older formations. This is followed by greensands and glauconitic chalk, which formations are thus lithic rather than stratigraphic units, being of Aptian age in southeast England, of Cenomanian age in southern Antrim, Ireland, and of Senonian age in northern Antrim. The age of the base of the pure chalk varies in like manner. From the detailed analysis of the sponge faunas of Great Britain, it appears that there was in general a corresponding shifting in the maxima in the same general direction, the siliceous sponges of the Cenomanian, Turonian and Emsherian, being confined to the southern and southeastern counties, while the Senonian sponge fauna is best represented in Norfolk and Yorkshire.

A similar transgressive character of the Cretaceous sea and corresponding overlap and change of facies of the sediments is seen in the deposits which underlie the Tertiaries of the Paris Basin, and which are structurally stratigraphically and faunally united with those of southeast England and belong to the sediments of the Boreal sea of Cretaceous time. Marine conditions in part of this region began however in Lower Cretaceous time. The deposits of southern France, together with those of the Alps, belong to the persistent Tethys sea, and here extensive marine limestones accumulated in Lower Cretaceous time as well. The Cretaceous deposits of northern Germany (indicated upon an excellent copy of Walther's map, which unfortunately is reproduced on too small a scale), and those of Bohemia, also illustrate the transgressive character of the Cretaceous sea, most extensive in the Cenomanian, and further show a striking general change in facies from prevailingly sandy (Quadersandstein) on the east to calcareous character on the northwest, the calcareous facies beginning as intercalations of thin-bedded limestones (Pläner) in the sandstone series. Local contributions of sands from the Harz uplands, etc., also modify the facies, but the main events of Cretaceous paleogeography of the northern European basin as indicated by the sediments were the progressive transgression of the sea towards the west and north and the simultaneous advance of the terrigenous sands from the Bohemian and Vienna regions over the calcareous deposits, the two types being in the relation of replacing overlap. This is the key to the distribution of the sponge fauna of the several districts.

The bibliography which is limited to Cretaceous Silicispongiæ and important stratigraphic papers contains 280 titles all of which except 24 were consulted by the author, surely a remarkable piece of industry when it is considered that many of these are monographic works, and that several European languages are represented.

A few typographical errors have crept in, those noted being as follows: p. 52, end first paragraph, the reference to the *following table* should be to the *preceding table;* p. 61, *Wealden anticline* is used instead of *Wealden anticlinal* as elsewhere, to indicate the compound character of this structure.

Altogether the work here reviewed is most creditable, alike to the author and to the geological-paleontological department of the museum, and while it does not pretend to be an original contribution either to spongiology or to European stratigraphy, it is distinctly one in its keen analysis of European literature, and in the synthesis of the important facts of European stratigraphy into a comprehensive and very readable unit and for this American students will be grateful to the author.

A. W. Grabau

ORGANIZATION OF THE AMERICAN SECTION OF THE PROPOSED INTERNATIONAL GEO-PHYSICAL UNION

At the invitation of the Royal Society issued June 17, 1918, an Inter-Allied Conference on International Scientific Organizations

was held in London from October 9 to 11, 1918. A further conference was held in Paris from November 26 to 29, 1918, at which organization was advanced, and the designation "International Research Council" was adopted.

At the Paris conference resolutions were passed by this International Research Council in favor of the establishment of an International Geophysical Union, "for the purpose of initiating and promoting researches in geophysics." The fields in science to be comprised under this title were not completely specified and only two sections were proposed at that time, viz.:

(*a*) A section dealing with geodesy and allied branches of science, such as the study of tides and mathematical "cartography;"

(*b*) A section of meteorology, with which shall be associated terrestrial magnetism, seismology and vulcanology;

but it was intended that other sections should be provided for. In these resolutions it was provided that "National Committees"[1] shall be appointed under the authority of the principal academy of science in each country, or by its government.

Following this an informal meeting of the Division of Physical Sciences, and invited guests, was held in Washington, D. C., on February 27, 1919, in response to a call by Mr. George E. Hale, chairman of the National Research Council, at which the actions of the London and Paris conferences were reported and discussed, and the general subject and content of the field of geophysics was considered.

A committee, consisting of Messrs. R. S. Woodward, chairman, L. A. Bauer, Wm. Bowie, Whitman Cross, A. O. Leuschner and C. F. Marvin, was appointed to consider the organization of an American Section of the proposed International Geophysical Union. Under date of March 4, 1919, this committee submitted the following report:

[1] Following the precedent in astronomy, in the United States the "National Committee" has been designated the "American Section," of the proposed International Geophysical Union.

To the Chairman of the National Research Council:

Your committee appointed to consider the question of a logical and practicable organization of the proposed American Section of the International Geophysical Union respectfully submits the following report:

The earth is at once the subject and the object of many sciences. Of these the most important are astronomy, geodesy, geology, meteorology, seismology, terrestrial magnetism, terrestrial electricity, tides and vulcanology.

While each of these sciences is more or less distinct in itself, they are closely related to one another, and progress in any one of them may be expected to depend to a great extent on the general progress attained in the others. Each of these sciences has its devotees and its experts, and the number of these in the aggregate is now very large. Hence in any scheme of effective organization it is essential to secure groupings of these various subdivisions of geophysics in order that the number of groups may not be too unwieldy in the transaction of business essential to such organizations. But it should be distinctly understood that in recommending a limited number of groups for purposes of administration it is not desired to discourage relations of closest reciprocity between the devotees to the various sciences included in the groups. On the contrary, it is the opinion of your committee that progress in the future is most likely to result from active cultivation of the borderlands that now serve to diminish, but only indefinitely, the several fields of geophysics.

It should be understood also that the groupings recommended are to be regarded as provisional and subject to such changes as future experience may suggest. It is recognized also that the groupings here recommended may not be the most appropriate for all countries or possibly for an international organization, since much regard should be given in all such matters to historical precedents and to the circumstances presented at any epoch by individnal investigators, and especially by governmental organizations, of any country.

With these reservations the committee recommends that the following groups of subjects should be recognized in the organization of the American Section of the International Geophysical Union:

Group 1: Geodesy. This group may be assumed to deal with questions concerning the size, the shape and the mechanical properties of the earth.

Group 2: Seismology and Vulcanology.

Group 3: Meteorology and Mareology, including especially all questions presented by the mechanical properties of the atmosphere and the oceans.

Group 4: Terrestrial Magnetism and Terrestrial Electricity. This group is intended to deal with the magnetic and the electric properties of the earth, including its atmosphere.

The committee recommends that initially the designation of members to constitute the proposed Geophysical Section be made by the National Academy of Sciences. It is further recommended that in making such designations regard be had to the desirability of securing representatives from the following government bureaus:

Bureau of Fisheries,
Bureau of Mines,
Bureau of Standards,
Coast and Geodetic Survey,
Hydrographic Office, U. S. N.
Geological Survey,
Weather Bureau.

Similarly, the committee suggests that representatives also may be fitly chosen from the following national societies:

American Astronomical Society,
American Mathematical Society,
American Physical Society,
Geological Society of America,
Seismological Society of America.

The committee further recommends that in order to promote research and discovery in geophysical science in general steps be taken by the American Section of the International Geophysical Union toward the formation of a new society to be called the American Geophysical Society.

Signed: R. S. WOODWARD,
for the Committee

This report was referred to the Division of Physical Sciences of the National Research Council, and was considered by this division at a special meeting held on March 10, 1919, called, in part, "to consider the organization of a Geophysical Section of the division to represent the division on the proposed International Geophysical Union." After discussion the Division of Physical Sciences voted to recommend to the Council of the Academy and to the Executive Board of the National Research Council.

1. The approval of the organization of a Section on Geophysics, to include the following groups of subjects:

Geodesy,
Seismology and Vulcanology,
Meteorology and Aerology,
Earth and Ocean Tides and Mareology,
Terrestrial Magnetism,

with the provision that the exact designation of subjects to be included and their grouping be determined by the section after its organization, in harmony with the general plans of the International Geophysical Union.

2. That the question of the formation of a geophysical society be referred to the Geophysical Section after its formation;

3. That the initial membership of the Section on Geophysics be constituted as follows:

Messrs. J. F. Hayford, R. S. Woodward, William Bowie, Joseph Barrell, Frank Schlesinger, A. O. Leuschner, E. W. Brown.

Messrs. H. F. Reid, J. C. Branner, H. O. Wood, A. L. Day, R. A. Daly, R. B. Sosman, Whitman Cross.

Messrs. A. G. McAdie, C. F. Marvin, W. J. Humphreys, E. H. Bowie, W. R. Blair, Max Mason, R. A. Millikan.

Messrs. G. W. Littlehales, J. T. Watkins, A. A. Michelson, F. R. Moulton, G. F. MacEwen, H. B. Bigelow.

Messrs. L. A. Bauer, S. T. Barnett, R. L. Faris, W. F. G. Swann.

On April 15, 1919, upon recommendation of Mr. A. O. Leuschner, acting chairman of the Division of Physical Sciences, the executive board of the National Research Council made the following appointments:

1. *Acting Chairman of the American Section of the proposed International Geophysical Union*, Mr. William Bowie.

2. *A committee to prepare recommendations regarding international cooperation in geophysical subjects for consideration by the American Section of the proposed International Geophysical Union*, Messrs. R. S. Woodward, *chairman*, L. A. Bauer, William Bowie, Whitman Cross, A. O. Leuschner, C. F. Marvin and H. F. Reid, with power to increase its membership.

At its first meeting, on May 20, 1919, this committee assumed the title, Provisional Executive Committee, and added Mr. H. O. Wood to its membership as its secretary.

3. *A Committee on Variation of Latitude of the American Section of the proposed International Geophysical Union to confer with a similar com-*

mittee of the American Section of the proposed International Astronomical Union to make joint recommendations with this Committee in regard to the future organization of researches on the variation of latitude, Messrs. William Bowie, chairman, F. R. Moulton and C. F. Marvin.

The executive board also determined that the organization meeting of the American section of the proposed International Geophysical Union should be held in Washington, in conjunction with the June, 1919, meeting of the American Section of the proposed International Astronomical Union, and that pending that meeting further organization of the American Section of the proposed International Geophysical Union should be left with its acting chairman with power.

At the meeting of the Interim Committee of the Executive Board of the National Research Council, on May 20, Mr. H. O. Wood was appointed acting secretary of the American Section of the proposed International Geophysical Union.

In preparation for the organization meeting and for the meetings in Brussels in July, 1919, of the International Research Council and the International Geophysical Union, four meetings of the Provisional Executive Committee were held, on May 20, June 3, June 10 and June 17. The organization meeting was held in three sessions, on June 24 and 25, 1919, at the building of the National Research Council, in Washington, D. C.

A digest of the action taken at these meetings is given below:

At the first meeting of the Provisional Executive Committee on May 29 the following gentlemen were designated as committees of one to prepare brief statements for the use of the delegates to the meetings at Brussels in regard to the past history, present status, and scientific purposes of each of the following international scientific bodies:

1. International Geodetic Association, Mr. Wm. Bowie.

2. International Seismological Association, Mr. H. F. Reid.

3. (*a*) International Meteorological Committee and (*b*) International Committee for the Study of the Free Atmosphere, Mr. C. F. Marvin.

4. International Commission of Terrestrial Magnetism, Mr. W. J. Peters.

Also Mr. R. S. Woodward, as chairman of the committee, was requested to prepare a brief statement for the use of the delegates in regard to the past history, present status, and scientific purposes of geophysics as a distinctive field in science.

As a result of discussion with respect to the appropriate place of vulcanology in the organic scheme Mr. Whitman Cross was requested to prepare a statement in regard to vulcanology similar, so far as possible, to those regarding the other subdivisions of geophysical science in their international aspects.

Two printed pamphlets issued by the Royal Society, entitled "Proposals for the Convention for an International Union of Geophysics—Approved by the Royal Society" and "International Geophysical Union," were read and discussed, and Mr. Leuschner was requested to prepare a clarifying statement in regard to foreign proposals for organization.

A committee consisting of the acting chairman of the American Section and the Chairman of the Provisional Executive Committee was appointed to consider the appointment of delegates to the Brussels meeting.

A Committee on Publications was appointed, consisting of the acting chairman and the acting secretary of the American Section, and Messrs. F. E. Fowle and G. S. Fulcher.

At the second meeting of the Provisional Executive Committee, on June 3, considerable time was devoted to the consideration of a project for geophysical investigations in the Arctic regions in cooperation with Roald Amundsen's expedition, under the auspices of the Norwegian government, which had been brought to the attention of the National Research Council by the Director of Naval Intelligence. Recommendations with respect to feasible action were made by the committee which were transmitted by the acting chairman of the section to the council.

Mr. Leuschner read a clarifying statement in regard to foreign proposals for organization which he had been requested to prepare. The substance of this, omitting illustrative

information given at length, is summed up in the following paragraph.

A large number of formal and informal international scientific organizations existed previous to the war. As a result of it these have lapsed, effectively, and in some cases the terms have expired during the course of the conflict. Because of the war the International Association of Academies has become defunct practically. A strong effort is being made to reconstitute the latter in the "International Research Council," and at the same time, to reconstitute, centralize, simplify in organization and minimize in number the previously very numerous international scientific organizations as "International Unions" affiliated with the International Research Council.

Attention was given to a "Proposed International Hydrographic Conference to be held in London in June, 1919," and action was recommended intended to secure a suitable correlation of this with the interests of the Mareological subsection as represented at Brussels.

A report was read by Mr. Bowie, for the Committee on Variation of Latitude which met jointly with the committee of the same title of the American Section of the proposed International Astronomical Union; and the report was approved for transmittal to the section.

A report was read by Mr. Wood, for the Committee on Publications, which was approved for transmittal to the section.

At the third meeting of the Provisional Executive Committee, on June 10, in connection with consideration of delegates to the meetings in Brussels, action was recommended to the chairman of the National Research Council toward the appointment of men already delegated to attend the Hydrographic Conference in London.

A Committee on the Investigation of Earth Tides, consisting of Messrs. A. A. Michelson, chairman, T. C. Chamberlin and F. R. Moulton, was appointed in response to a communication from Mr. Moulton recommending action on this subject.

A request from the Division of Geology and Geography to the Division of Physical Sciences that a member of the latter division be appointed to represent the division on a committee of the Division of Geology and Geography to consider a specific project in seismology, was referred to this committee and the acting chairman of the American Section was requested to recommend to the Division of Physical Sciences a member of the division to be appointed to serve with the committee of the Division of Geology and Geography.

After brief comments on the subject Mr. Bowie was requested to prepare a statement in regard to isostasy for the June meeting.

At the fourth meeting of the Provisional Executive Committee, on June 17, further consideration was given to the matter of the delegates to the Brussels meeting and of the instructions or advice which should be given them.

After discussion it was the sense of the committee that the delegates to Brussels should have power to confer for the purpose of arriving at definite understandings in regard to the future status of international organization in science.

But, in order to provoke discussion and the free exchange of ideas in regard to this it was decided to transmit to the section the following recommendations:

That the International Research Council take such steps as are required to perpetuate the work of international organizations in science, if necessary by terminating previously existing arrangements, whether informal or dependent upon treaties or conventions; and

That the International Research Council recommend to the appropriate international unions the appointment of suitable committees on special subjects where continuation is desirable or necessary to provide plans for resumption and continuation of organization.

The opinion was stated that definite action to terminate previous international arrangements would probably be necessary in most cases.

The plan of the Royal Society in regard to financing the administration of the International Geophysical Union was discussed in

connection with a general consideration of this problem and certain specific details.

It was the sense of the committee that geochemical investigation should have appropriate representation in the American Section of the proposed International Geophysical Union.

It was recommended to postpone the question of the formation of an American Geophysical Society until after the Brussels meeting.

Harry O. Wood,
Acting Secretary

(*To be concluded*)

SPECIAL ARTICLES

BACTERIUM SOLANACEARUM IN BEANS

In June, 1919, some badly diseased bush beans were received from Lynn Haven, Florida. The leaves were wilted and more or less brown. Often the petioles also were brown and wilted to their base. The roots were brown and the epidermis somewhat decayed in places. The woody parts of the plants, both stems and roots, had dark stained vascular bundles. Cross sections examined microscopically showed from 50 to 100 per cent. of the vessels to be full of bacteria and no fungi were visible. As the discoloration of the leaves was generally uniform, with no lesions apparent while the roots showed lesions and contained bacteria in great numbers the supposition was that the disease must be due to the bacteria and that they must have entered through the root system. The loss in the Florida field was about 20 per cent. of the beans planted.

Agar-poured plates gave pure cultures of a white bacterial organism having all the characteristics of *Bacterium solanacearum*.

Cultural work in other media and needle-prick inoculations made with sub-cultures of colonies taken from the poured plates confirmed this diagnosis.

A number of different legumes were inoculated by pricking the bacteria into the stems. Of beans, Waxbush, Red Valentine and Refugee proved very susceptible. These plants began to wilt two days after inoculation and a number were entirely wilted and fallen over in seven days. In addition to those already mentioned, good infections were secured in: Lima beans (Fordhood variety), Pinto beans (a brown speckled variety) and Great Northern (a white Navy bean).

Inoculated in peas this parasite acts more slowly than in beans, but is not without pathogenic properties at least on some varieties. Following stem inoculation by needle pricks there is a slow drying and shriveling of the leaves but not a sudden wilt. The plants become stunted. Cross sections of the stems show bundles discolored and containing bacteria though in less abundance than in infected beans, tobaccoes, or tomatoes. Telephone, Little Marvel and Mammoth Luscious Sugar were the varieties of peas that became infected. The organism has been reisolated from both beans and peas, and proved to have the same characters and infectiousness (tested on tobacco and beans), as the original culture.

The organism was also found to be infectious to soy beans (variety Ito San) and to cowpeas (variety Black Cow).

Tobacco and tomato plants used for control showed typical *Bacterium solanacearum* infections.

So far as known this is the first time this disease has been observed in beans, peas, soy beans or cowpeas, although known to occur in peanuts, in *Mucuna* sp., and in some other legumes. Fortunately beans appear to be very susceptible only in early stages of growth.

Erwin F. Smith,
Lucia McCulloch

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

NOT TEN BUT TWELVE!

THERE has come to my hands a petition in the form of an open "Letter to Lord Balfour" ("Chairman on Weights, Measures, Coinage, etc."), circulated in the name of the "World Trade Club," and calling upon "United States American President, His Excellency Woodrow Wilson, United States American Congress, etc.," and "British Premier, His Excellency David Lloyd George, Houses of Parliament, etc.," for "legislation, promulgation, Orders in council that will bring about the exclusive use of Meter-Liter-Gram by the United States of America" and "The British Isles."

As the matter is of far-reaching scope and prime importance, may I be allowed a word of earnest protest.

The reasons advanced in the fifteen pages of argument, on disregarding the ill-advised and ill-founded appeal to national prejudice against the alleged Germanic character of our present system (or chaos), amount merely to the oft-repeated affirmation that the metric system, being consistently decimal, is far simpler, more convenient, and time-saving than any non-decimal system, since reductions from unit to unit are made merely by shifting the point, as in dollars and cents. That herein lies a certain very considerable convenience is not denied in any quarter and needs no detailed exposition. Also the advantage of world-wide uniformity in weights, measures, and coinage are plain and uncontested. But this latter fact is no reason for the Anglo-Saxon world to pass over to the Latin-German system, rather than for the latter to yield to some far superior system of the former. While conceding all that may be said with any show of reason in favor of a decimal system, we must not forget nor disguise the very grave disadvantages that inhere ineradicably in it, especially in its cum-

brous expression of many simple, important, and frequent fractions, as 1/3, 1/4, 1/6, 1/8, 1/9, 1/12, etc. We protest most earnestly against the adoption of the Latin-German system, not because it is not better than our present lack of all system, but because such adoption would *postpone perhaps forever the introduction of a far superior system,* which is a capital desideratum of our modern civilization and life. The meter-liter-gram is at least in some ways comparatively good, but the good is the enemy of the best, with which only we can rest content, and it would be an infinite blunder to establish and eternize such a defective system as the M.L.G. when it is almost as easy—at least, when it is entirely possible—to introduce and establish once and for all time the best system that the nature of number and of the human mind permits.

This best of numerical systems is not the ten-system (which is recommended only by the fact that man has ten fingers and ten toes!) but the twelve-system, whose virtues are imbedded in the nature of number itself. Its notation requires at once the introduction of *two new symbols,* one for ten, one for eleven, which may be made as pretty and simple as you will, but the initials *t* and *e* will answer all present purposes. We shall have then the ciphers: 1, 2, 3, 4, 5, 6, 7, 8, 9, *t, e.* Twelve is then to be written 10, and we shall have the next set; 11, 12, 13—19, 1*t,* 1*e,* 20—to be read tel-one, tel-two, tel-three, . . ., tel-nine, tel-ten, tel-len, *twentel.* The reasons for such names are obvious, *tel* and *len* are natural simplifications of twelve and eleven. Our present forms, such as sixteen, seventeen, which read the numbers 16, 17 *backwards,* are a stumbling-block to beginners, hindering and confusing them to no purpose whatever. Twentel (20) equals of course our present twenty-four. Similarly thirtel-one, etc., fortel, fiftel, sixtel (sistel), sentel (for seventel), eightel, ninetel, tentel, lentel, teltel. This last, 100, equal to our present 144, is of course the second power of the base twelve (10), and should have some appropriate name, as *dipo,* or *two-po,* or whatever may seem best, and similarly the higher powers, as 1000(1728), 10,000(20,736, etc.).

We see here at once the greater *power* of this system; with four figures it expresses numbers up to 20,735 (e e e e in the twelve-system), more than twice as many as are so expressible at present—an advantage that steadily increases with the numbers, and shows itself clearly in logarithmic and other tables, where, with the same number of figures, the accuracy of expression would be sensibly higher. Thus, a unit in the sixth decimal place now signifies a millionth, in the Tel-system it would mean about a three-millionth. In the billions, the Tel-notation economizes one place.

Among the many advantages shared by this system with no other, the chief is the high factorability of the base twelve, divisible exactly by 2, 3, 4, 6, and simply related to 8 and 9. Thence result extremely simple expressions for the principal fractions:

1/2 = .6
1/3 = .4
1/4 = .3
1/6 = .2
1/8 = .16
1/9 = .14
one twelfth = .1
1/14 = .09
1/16 = .08
1/20 = .06, etc.

The fractions 1/5, 1/7 one tenth, one eleventh (111 . . . .) remain interminate series, but for them we have little practical use. With the foregoing compare the current decimal expressions for the fundamental constantly recurring fractions:

1/2 = .5
1/3 = .33333 · · ·
1/4 = .25
1/6 = .16666 · · ·
1/8 = .125
1/9 = .111
one twelfth = .08333 . . .

and the great superiority of the tel-system becomes evident.

The multiplication table[1] becomes markedly simplified. No one has any trouble now in multiplying by 5, because of its simple cycle, 5, 0 (as in 5, 10, 15, 20, etc.): 4 has the much longer, more involved cycle, 4, 8, 2, 6, 0, (as in 4, 8, 12, 16, 20, etc.); 6 has the cycle 6,

2, 8, 4, 0 (6, 12, 18, 24, 30); 8, the cycle 8, 6, 4, 2, 0. Compare with these the cycles in the Tel-system: 2(2, 4, 6, 8, t, 0), 3(3, 6, 9, 0), 4(4, 8, 0), 6(6, 0), 8(8, 4, 0), 9(9, 6, 3, 0), and the surpassing simplicity of this system is again apparent. A child will learn this multiplication table with much less effort than the ten-table, and will find the range of its power and the scope of his attainment just 44 per cent. greater (since 100 in the tel-system = 144 in the ten-system).

1	2	3	4	5	6	7	8	9	*t*	*e*
2	4									
3	6	9								
4	8	10	14							
5	*t*	13	18	21						
6	10	16	20	26	30					
7	12	19	24	2*e*	36	41				
8	14	20	28	34	40	48	54			
9	16	23	30	39	46	53	60	69		
t	18	26	34	42	50	5*t*	68	76	84	
e	1*t*	29	38	47	56	65	74	83	92	*t*1

1	2	3	4	5	6	7	8	9
2	4							
3	6	9						
4	8	12	16					
5	10	15	20	25				
6	12	18	24	30	36			
7	14	21	28	35	42	49		
8	16	24	32	40	48	56	64	
9	18	27	36	45	54	63	72	81

Compare these two multiplication tables. In the ten-table the end digits are: 0, 4 times; 1, 2 times; 2, 5 times; 3, 1 time; 4, 6 times; 5, 4 times; 6, 6 times; 7, 1 time; 8, 5 times; 9, 2 times. In the tel-table the end-figures in the corresponding products are: 0, 8 times; 1, 2 times; 3, 3 times; 4, 6 times; 6, 6 times; 8, 4 times; 9, 4 times; *t*, 2 and *e* each 1 time; 5 and 7, not at all, though each occurs once of course, in the products of e. Notice the much greater simplicity, due to their absence and to the presence of 0, 8 times. Notice also the simplicity in the squares, and the double central symmetry in 1, 4, 9, 4, 1, 0, 1, 4, 9, 4, 1, and compare with the 1, 4, 9, 6, 5, 6, 9, 4, 1 of the ten-table, also an anagram but with only single symmetry, and with 5 different digits against only 4 in the tel-system, which is thus notably simpler.

The year is divided into twelve months, and no other division is likely within any forseeable time. Accordingly, in time-reckoning the advantages of the tel-system are obvious. In this notation the number of days in the year is 265. To each month we should by all means assign the same number of days, thirty (30) as now or twentel-six (26) in the tel-system: that is, 260 month-days in all; the remaining 5 should be extra-mensual, legal holidays, easily and instructively distributable over the year, with a sixth such in leap years. Monthly and annual accounts and rates would be turned into each other by merely moving the point one place to right or left. If one received $100 a month, one would receive $1,000 a year; if the interest rate was 6 (per dipo) per year, it would be .6 per month. Similarly the day is already divided into (twice) twelve hours, that is, 20 in the tel-system. The circle (or round angle) is now divided into 360 degrees (or 250 in the tel-system); this Babylonian division is unfortunate but may be easily conformed to the divisions of the clock-face into twelve parts, each of these divided into twelve (stretches of 5 minutes or of 2 1/2 degrees), each of these into twelve again, and so on. With our established time-divisions the ten-system can never be harmonized.

The better unit of coinage is the American quarter, the English shilling (German mark). The dollar is too large, a fact in some measure responsible for the sinful and ruinous extravagance of American life. The shilling is already divided into twelve pence, a division that admits of no improvement; it remains only to be consistent and to coin the twelve-shilling piece (a convenient coin, which might be named twilling or tel-quar); with its fractions and multiples, which Anglo-American commerce would spread all over the earth. So, too, the foot is already divided into twelve inches. To convert inches and feet into each other, it would be necessary only to move the point.

The meter has no superiority over the yard;

if the latter be taken as standard, it should be divided into twelfths (or telths), and these again into twelfths, etc. The mile might be slightly reduced to 1,728 yards (in the tel-system 1,000 yards, 3,000 feet). All such details and all proper preliminaries to the passage from ten to twelve could be worked out by scientific committees appointed for the purpose, once the number twelve is laid at the base of our numeration, notation and all forms of measurement—a position for which it is uniquely fitted.

One and only one objection can be made to this proposal, namely, that it is impractical, infeasible and visionary. We dare not answer with the favorite Scripture, "Where there is no vision, the people perish," for this sentiment alas! is foreign to the Hebrew proverb. But the objectors themselves reject with scorn the similar objection to the introduction of the metric system, that it is impractical and visionary and could only with great difficulty be effected. It is the stock objection of all conservatism, the objection that confronts every effort to rationalize, humanize, beautify, glorify and justify our life on earth, the objection that it can not be done! The same has been said of a hundred proposals, all declared unrealizable, and all now actually realized. It may be hard to answer Zeno's arguments against the possibility of motion, but it is none the less easy to move! So it will be with the change from ten to twelve. Attempted, it will be accomplished. Not in a day or a year, but at most in a generation. Let the children be taught the tel-system year after year. The time necessary to learn it will be quite inconsiderable. Once learned, it will also be loved. In the meantime scientific commissions can go over the whole ground carefully and prepare the way in the wilderness and level up in the desert a road for the age to come. When the change is finally carried into effect, the jar of switching off the ten-track to the twelve-track will be much less severe than we now imagine. But it will bring incalculable blessings to all future generations. The great giant arithmetic will be shorn of half his terrors. It is very common in these loud-mouthed days to make Brobdingnagian pretensions. We are told that each of a score of trifles (base-ball among them) won the war, when each made only a paltry contribution to the collective result. So we are assured that each of many things would have abridged the war by months or years. The World Trade Club informs us that had Congress adopted the "meter-liter-gram legislation before Congress (1904), the war would have been shortened two years." If a few other such things had been done, perhaps the war would have been stopped like Buck Fanshaw's riot, before it was started or even imagined! As such indebtedness heaps up on all sides, one is reminded of the famous couplet:

> Owen More has run away,
> Owin' more than he can pay.

We are further assured that

> Clyde Wolfe, Master Mathematician, University of California, writes: A conservative estimate is that the exclusive use of meter-liter-gram would shorten the time of teaching arithmetic to the average child by 2 years.

If so, then the substitution of twelve for ten as a base ought to shorten it by at least four years. No such claim is made here, but it is affirmed that a very large and sorely needed saving of time and energy would be effected, and that if the introduction of the thoroughly rational twelve-system should be supplemented by the adoption of a thoroughly rational alphabet, with one-to-one correspondence of sign and sound, then would the words of the English language indeed be winged and fly over all the earth, then would our Anglo-American civilization lead the van of progress, and its commerce would fulfil the boast of its poet:

> Trade is the golden girdle of the globe.

William Benjamin Smith

A NATIONAL INSTITUTE OF NUTRITION

In a recent issue of Science (August 1, 1919) Lusk calls attention to a reconstruction problem which seems in danger of receiving less consideration than its fundamental significance demands, viz., the food problem, vital

to the very existence of civilization, and proposes as one agency for its study the foundation of a national laboratory of human nutrition. The importance of the subject is such that Lusk's proposal seems to invite discussion on the part of those more or less directly interested in the science of nutrition and its utilization for the benefit of humanity. Accordingly I venture to submit for consideration certain personal notions regarding the kind of organization which is desirable and as to steps which might be taken to secure it.

It is to be remarked in the first place that the subject of national (and still more of international) nutrition is a very broad one, involving much more than the mere laboratory study of the laws of human nutrition, important as that is. It is a two-fold subject, including the economical production of food as well as its efficient utilization. The farmer, like other producers, rightly desires a reasonable reward for his services. The interests of the consuming public demand a liberal food supply at prices low enough to ensure the adequate nourishment of all classes of the community. It should be the aim of any national organization of students of nutrition to contribute to the harmonizing of these apparently conflicting interests and to demonstrating that in the large view they are not antagonistic. Accordingly I feel inclined to broaden the caption of Lusk's article and to speak provisionally of a national institute of nutrition.

In the organization of such an institute there are certain general principles which should, as I think, control.

1. It should not be burdened with executive duties. Questions of transportation, marketing, cold storage, profiteering, price control, rationing, etc., should be recognized as subjects lying outside its field and with which students of nutrition as such are not specially qualified to deal. In brief, it should not be an executive department of the government nor have the functions of a food administration but should supply to legislative and executive authorities the scientific data upon which any successful measures of food policy must be based.

2. It should be distinctly national in character and should be a means of integrating and coordinating without controlling the activities of the various existing agencies of investigation. It should be so constituted that it may represent the United States officially in any international conference involving questions of nutrition.

3. It should be under the control of scientific men and not subject to the vagaries of legislative bodies nor dependent upon them for annual appropriations with the accompanying pressure to emphasize popular and spectacular work. This is an additional reason for not making it an executive department.

The natural organizing authority of such an institute as is here contemplated would seem to be the National Research Council. Both because of its intimate relations with the National Academy of Sciences and by virtue of the executive order of May 11, 1918, it is recognized as a national body representing the organized scientific activities of the United States. Moreover, the Research Council has already taken a first step in the direction indicated by authorizing the appointment of a committee on food and nutrition. Presumably the purpose has been to select a committee representative of the nutrition investigators of the country while the matter is still sufficiently fluid to permit of any necessary modifications. Here, as it seems to me, is an ideal body to constitute a board of control of the proposed institute. It would determine, subject to the approval of the National Research Council, the general policy of the institute, while the immediate administration would naturally be confided to a director selected or nominated by the governing body and responsible to it but given large discretionary powers.

It would be premature to attempt to outline in any detail the field of work of a national institute of nutrition but it would seem that it would rather naturally divide itself into four sections:

I. *Statistical.*—What are the total food requirements of the United States? What is the actual food consumption and how much of this is avoidable waste? How is food consumption and food waste distributed among different classes of

the population? What is our total food production, and can it be modified so as to secure more efficient utilization? Information on these and related questions should be kept up to date and available, using present statistical data so far as they suffice and collecting additional data if needed.

II. *Physiological.*—A scientific study of problems of human nutrition, such as those instanced by Lusk and others which might be added. The results of these investigations would afford the indispensable groundwork of the statistical studies just mentioned.

III. *Agricultural.*—A broad study of the economy of food production in the light of the food requirements of the nation and from the standpoint of the mutual interests of producer and consumer. All the innumerable problems of plant and animal nutrition would find their place here, as well as broader questions regarding the relative economy of production of animal and vegetable foods and of different classes of each and of the most economical level of production under varying conditions.

IV. *Extension and Publicity.*—A very important function of the institute would be to bring the results of its work effectively to the attention of the community and of legislatures and executives, and to impress on them its vast economic and social importance.

It goes without saying that such an institute should cultivate most cordial relations with existing agencies. It should supplement, not supplant. If wisely and conservatively directed it might do much to bring about cooperation and coordination in the activities of extension departments, of nutrition laboratories, of experiment stations, and of the research and statistical divisions of the department of agriculture, so far as they relate to nutrition. Whether its objects could be sufficiently attained in this way or whether its policy should include in addition the establishment of laboratories of its own would be a question for the decision of the board of control.

Finally, as regards financial support, I believe that if as the result of free discussion and comparison of views a scheme can be worked out which has the approval of the scientific men of the country and which commends itself to the National Research Council as practicable and as promising material benefit to the public, past experience warrants the belief that the necessary funds will be forthcoming.

H. P. ARMSBY

THE OSLER PRESENTATION

ON July 11, 1919, Sir William Osler, Regius professor of medicine in the University of Oxford, was honored by the presentation of two anniversary volumes, made up of medical contributions by English and American colleagues, commemorating his seventieth birthday (July 12). The presentation was made by Sir Clifford Allbutt at the house of the Royal Society of Medicine on behalf of some 150 subscribers and contributors, in the presence of a large and distinguished audience. The plan of a birthday memorial originated at Oxford, and was successfully carried through by a committee with Dr. William H. Welch as chairman, Dr. Casey A. Wood, as secretary and Dr. Henry Barton Jacobs as treasurer. In the early stages, the work was financed through the energy and initiative of Colonel Casey A. Wood, and the manuscripts were edited and carried through the press by Drs. Charles L. Dana (New York) and Charles Singer (Oxford).

Sir William Osler, the recipient of this unusual tribute, is looked up to and honored everywhere as a leader of British and American medicine. In succession, he has held the chairs of medicine at McGill (1874), the University of Pennsylvania (1884), the Johns Hopkins University (1889) and Oxford (1904). His eminence in clinical medicine is based upon an extraordinary knowledge of pathology, acquired in his early days at Montreal, and upon the fact that he has taught medicine to students inductively, away from the textbooks, and by direct contact with the sick in the wards. At an early age (1874) he described the blood-platelets, which he was the first to define as the third corpuscle of the blood and in relation to the formation of thrombi. He also discovered the parasite of verminous aneurism (*Filaria Osleri*), first pointed out the relation between mycotic

aneurism and mycotic endocarditis, first described the ball-valve thrombus at the mitral orifice, the visceral complications of erythema multiform (1895), chronic cyanosis with polycythemia (1895), the erythematous spots in malignant endocarditis (1908), and other clinical minutiæ recorded in the bibliography of 730 titles in the Osler number of the *Bulletin of the Johns Hopkins Hospital* (July, 1919). These discoveries are all the more remarkable, in that Osler's life has not been that of the laboratory physician, but one of absolute and exclusive devotion to his patients and his pupils. No other physician has been such an universal friend to his colleagues, to students and to the younger members of his profession. He enjoys the esteem and affection of the entire medical profession.

An account of the presentation is given in the *British Medical Journal* (July 19, p. 80):

In presenting the volumes, Sir Clifford Allbutt said:

In these volumes we hope you will find the kind of offering from your fellow workers which will please you best—immaterial offerings indeed, but such as may outlive a more material gift. As to you we owe much of the inspiration of these essays, and as in many of their subjects you have taken a bountiful part, so by them we desire to give some form to our common interests and affections.

We pray that health and strength may long be spared to you and to her who is the partner of your life; and that for many years to come you will abide in your place as a Nestor of modern Oxford, as a leader in the van of medicine, and as an example to us all.

In reply Sir William Osler said:

Sir Clifford Allbutt, Ladies and Gentlemen: As the possessor of a wild and wagging tongue that has often got me into trouble, I thought it would be better on such an occasion to make full notes beforehand of what I wanted to say. Two circumstances deepen the pride a man may justly feel at this demonstration of affection by his colleagues on both sides of the Atlantic—one, that amid so much mental and physical tribulation my friends should have had the courage to undertake this heavy two-volume task, and the other, that this honor is received at the hands of my brother Regius, a friend of more than forty years. (Applause.) There is no sound more pleasing than one's own praises, but surely an added pleasure is given to an occasion which graces the honorer as much as the honored. To you, Sir Clifford, in fuller measure than to any one in our generation has been given a rare privilege; to you, when young, the old listened as eagerly as do now, when old, the young. (Applause.) Like Hai ben Yagzan of Avicenna's allegory, you have wrought deliverance to all with whom you have come in contact.

To have enshrined your gracious wishes in two goodly volumes appeals strongly to one the love of whose life has been given equally to books and to men. A glance at the long list of contributors, so scattered over the world, recalls my vagrant career—Toronto, Montreal, London, Berlin and Vienna as a student; Montreal, Philadelphia, Baltimore and Oxford as a teacher. Many cities, many men. Truly with Ulysses I may say, "I am a part of all that I have met."

Uppermost in my mind are feelings of gratitude that my lot has been cast in such pleasant places and in such glorious days, so full of achievement and so full of promise for the future. Paraphrasing my lifelong mentor—of course I refer to Sir Thomas Browne—among multiplied acknowledgment I can lift up one hand to heaven that I was born of honest parents, that modesty, humility, patience and veracity lay in the same egg, and came into the world with me. To have had a happy home in which unselfishness reigned, parents whose self-sacrifice remained a blessed memory, brothers and sisters helpful far beyond the usual measure—all these make a picture delightful to look back upon. Then to have had the benediction of friendship follow one like a shadow, to have always had the sense of comradeship in work, without the petty pinpricks of jealousies and controversies, to be able to rehearse in the sessions of sweet, silent thought the experiences of long years without a single bitter memory—to have and to do all this fills the heart with gratitude. That three transplantations have been borne successfully is a witness to the brotherly care with which you have tended me. Loving our profession, and believing ardently in its future, I have been content to live in it and for it. A moving ambition to become a good teacher and a sound clinician was fostered by opportunities of an exceptional character, and any success I may have attained must be attributed in large part to the unceasing kindness of colleagues and to a long series of devoted pupils whose success in life is my special pride.

To a larger circle of men with whom my con-

tact has been through the written word—to the general practitioners of the English-speaking world—I should like to say how deeply their loyal support has been appreciated. Nothing in my career has moved me more, pleased me more, than to have received letters from men at a distance—men I have never seen in the flesh—who have written to me as a friend. And if in this great struggle through which we have passed sorrow came where she has not been before, the blow was softened by the loving sympathies of many dear friends. And may I add the thanks of one who has loved and worked for our profession, and the sweet influences of whose home have been felt by successive generations of students?

To the committee and the editors I am deeply indebted for the trouble they have taken in these hard days, and to the publisher, Mr. Paul Hoeber, for his really pre-war bravery; and our special thanks are due to you, kind friends—and in saying this also I would associate Lady Osler with myself—who have graced this happy ceremony with your presence.

The ceremonies terminated with the proposal of a vote of thanks to Sir Clifford Allbutt by Sir D'Arcy Power, and concluding remarks by Sir Donald McAlister and Sir Clifford Allbutt.

F. H. GARRISON

ARMY MEDICAL MUSEUM

SCIENTIFIC EVENTS

MEDICAL EDUCATION AND PRACTISE IN CHINA

THE *Journal* of the American Medical Association calls attention to the fact that under the influence of several American and other missionary boards and by the aid of such prominent American medical schools as Harvard, Yale and the University of Pennsylvania, and with the generous financial assistance of the China Medical Board, which was organized by the Rockefeller Foundation, there has been great medical progress in China in recent years, and there are twenty-six medical schools in China. Five of these at present are members of the Association of Medical Colleges of China. Membership in this association is limited to colleges, which provide a four-year medical course, and which require for admission two or more years of college work, including courses with laboratory work in physics, chemistry and biology.

Two practically new medical schools, including premedical departments, are being erected as Peking and Shanghai by the China Medical Board of the Rockefeller Foundation. These are the Peking Union Medical College and the Shanghai Medical School. The plan is to make these equal to any other medical schools in the world in buildings and equipments, as well as in hospital facilities and in educational standards.

The Rockefeller Foundation is also aiding financially other medical schools in China, particularly the Shantung University School of Medicine at Tsinan, The Hunan-Yale College of Medicine at Changsha, and the medical schools of Nankin, Canton, Soochow and elsewhere.

A strong appeal is still being made for medical missionaries. In China, with an estimated population of more than 400,000,000 people, including Manchuria and Mongolia, there are said to be at present only 2,000 scientifically trained physicians. It is stated that at the end of 1917 there were 351 foreign medical missionaries who had working with them 212 foreign physicians. During that year these physicians cared for about 120,000 hospital inpatients. Although large, these figures do not begin to touch the great needs of medical service in that country.

The *Journal* notes that all civilized nations are interested in helping to provide better medical service in China for the sake of their own people, if not for the sake of the Chinese, because China is at present the source of many of the epidemics which are liable to sweep over the entire world. It is for the medical practise of the entire world to combat disease wherever it is found by checking it at its very source. If any physician would prefer to have a large practise regardless of the financial income involved, he would have no difficulty in securing it in China, where there is indeed great need of skilled medical service.

MINERAL PRODUCTION OF THE UNITED STATES IN 1918

THE Department of the Interior has issued a preliminary report on the mineral produc-

tion of the United States in 1918 for the purpose of making public as soon as possible the statistics collected by the U. S. Geological Survey for that year. The statistics given for most commodities are final; those for a few are only estimates based on incomplete returns; but on the whole the report gives a fairly complete record of the mineral output of the country during the year.

The total value of the minerals produced was about $5,526,000,000, more than half a billion dollars in excess of the value recorded for 1917, but the total quantity produced was less. The output of fuels was greater than in 1917, though somewhat less anthracite coal was marketed. The increase in the quantity of coal marketed was about 5 per cent. but the increase in value, due to higher prices, was more than 17 per cent. It is significant that though the increase in the quantity of petroleum marketed was only a little more than 4 per cent. the increase in value was over 32 per cent.

The value of the metals produced was about 3 per cent. greater in 1918 than in 1917. The figures show that less iron ore and steel were produced, but here again values were higher. A little more pig iron was made, though the quantity shipped was less. Copper and zinc not only in themselves but as the components of brass are perhaps next in importance to iron in the world's industry to-day, and in 1918 they stood high on the list of war metals. A little more copper but less zinc was produced, and the values of both were lower, that of zinc falling about 25 per cent. The output of the war metals manganese and chromite, used in hardening steel, was greater than in any preceding year. Chromite increased 88 per cent. in quantity and 275 per cent. in value over 1917, and the increases in manganese ore were 136 and 100 per cent., respectively. Less gold and silver were mined than for many years. Though the price of silver rose from 81 cents an ounce in 1917 nearly to 97 cents in 1918, the increase was not enough to cover the increased cost of mining.

The output of building material—clay products, building stone, cement, lime, gypsum—showed a great decline.

The domestic productions of potash in 1918 was 54,000 tons, an increase of 68 per cent. over the output in 1917.

FIFTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

THE forthcoming National Exposition of Chemical Industries at the Coliseum and First Regiment Armory, Chicago, during the week of September 22 to 27, inclusive, promises great benefit to American chemical industry as in the past during the war period when it contributed so directly to the advance of chemical industry in this country. The meetings of the societies which are being held in conjunction with the exposition are as follows:

American Institute of Mining and Metallurgical Engineers, September 22 to 27.

American Ceramic Society, September 24.

American Electrochemical Society, September 24 to 26.

At the opening exercises on Monday Governor Frank O. Lowden, will make the address of welcome, to which Dr. Charles H. Herty, chairman of the advisory committee will reply.

John W. O'Leary, president of the Metal Trades Association of Chicago, will give an address on "The relation of the chemist to the manufacturer." On Tuesday there will be a symposium on "America's case in chemistry," in which the speakers will be:

Technical Association of the Pulp and Paper Industry, September 24 to 27.

Chairman's address, Ellwood Hendrick.

"Dyestuffs," J. Merritt Matthews, editor, *Color Trade Journal*.

"Glassware," E. C. Sullivan, of Corning Glass Company.

"Optical glass," Harvey N. Ott, of Spencer Lens Company.

"Chemical porcelain," Herman S. Coors, of Herold China and Pottery Company.

"Essential mental minerals," J. E. Spurr, of the War Minerals Relief Committee.

"Laboratory supplies," C. G. Fischer, of Scientific Materials Company.

"Laboratory supplies," J. M. Roberts, secretary, Apparatus Makers Association of United States.

"Fine chemicals," H. T. Clarke, of Eastman Kodak Company.

Plans have been made for a joint session of the American Electrochemical Society with the Mining Institute upon the subject of "Electric steel and electric furnaces" on Wednesday of the week. This will be followed by another joint session on "Pyrometry," probably on Friday, when the following phases of the subject will be considered and discussed: Methods of Pyrometry, Industrial Pyrometry, Pyrometry and its Relation to Science. The Electrochemical Society is arranging a meeting on "Catalysis." About a hundred papers have been prepared for the meeting of the Mining Institute. Addresses of general interest include one by Dr. H. E. Howe, on "The organization and plans of the National Research Council with special reference to the Industries."

SCIENTIFIC NOTES AND NEWS

Dr. Theodore W. Richards, professor of chemistry at Harvard University, has been elected president of the American Academy of Arts and Sciences.

Major General Wm. L. Sibert, director of the Chemical Warfare Service, U. S. A., has been made a commander of the French Legion of Honor.

Professor Alexander Smith, head of the department of chemistry at Columbia University, was granted on July 10, the honorary degree of doctor of laws by the University of Edinburgh. The following was the introduction: "Alexander Smith, B.Sc., Ph.D., director of the chemistry department of Columbia University, New York.—A most distinguished graduate of our own university, Professor Smith has risen to the rank of a super-chemist in the United States, head of a department embracing many specialized professorships, and director of one of the most important laboratories in the new world. We congratulate Columbia University on the possession of a teacher and investigator of such rare ability, and we congratulate ourselves on the opportunity of laureating an *alumnus* whose success reflects no little lustre on the institution where he received his early training."

Clarence Ousley, assistant secretary of agriculture, has resigned, leaving the Department of Agriculture on July 31. He gave as his reasons that he had finished the work for which he went to the department during the war and that he could not afford longer to hold public office. In transmitting the resignation to the president, Secretary Houston expressed deep regret that Mr. Ousley felt obliged to leave the department and stated that he was constrained to recommend the acceptance of the resignation only in deference to Mr. Ousley's wishes. The retiring assistant secretary remains in Washington.

Dr. Samuel T. Orton, of the University of Pennsylvania Hospital, has been appointed head of the new psychopathic hospital at Iowa City, which is being erected at a cost of $150,000.

Dr. M. Ozorio de Almeida has been placed in charge of the recently organized section of physiology of the Institute Oswaldo Cruz in Rio de Janeiro.

Mr. F. J. Chittenden, the head of the Wisley scientific station and laboratory, has been appointed director of the Royal Horticultural Society's Gardens at Wisley.

It is stated in *Nature* that Dr. Shaiffer, of the University of Toronto, has been appointed expert in animal husbandry to the government of Mysore. He will work under Dr. Coleman, the director of agriculture.

The Bessemer medal of the Iron and Steel Institute for the present year has been awarded to Professor F. Giolitti, of Turin.

Lord Lee, of Fareham, has been appointed to the presidency of the British Board of Agriculture and Fisheries, in succession to Lord Ernle.

Gonville and Caius College, Cambridge, has elected to a fellowship Lieutenant-Colonel C. S. Myers, who has been university lecturer in experimental psychology since 1907, and is director of the university laboratory of experimental psychology.

Dr. S. W. Patterson has been appointed director of the Eliza Hall Institute of Re-

search, in connection with the Melbourne Hospital.

NILS B. ECKBO, a member of the Forest Service since 1907, has left for Pretoria, South Africa, to assume the duties of chief of wood investigations in the Forest Department.

DR. J. P. STREET, chemist in charge of the analytical laboratory of the Connecticut Agricultural Experiment Station and recently major in the Sanitary Corps of the United States Army, has been assigned by the National Canners' Association as chief inspector for the state of Indiana.

CAPTAIN EDWARD B. STEPHENSON, Engineers, U. S. A., formerly assistant professor of physics, University of North Dakota, who has been connected with experimental and development work in sound ranging for the past two years and with the Engineer School at Camp Humphreys, Va., has been honorably discharged from the military service and employed as physicist in charge of Ranging and Camouflage Development, Office, Chief of Engineers, Washington, D. C.

LIEUTENANT COLONEL C. G. STORM, Ordnance Department, U. S. A., chief of the Research Section, Ammunition Division, has been honorably discharged from the service and is now engaged in research work with the Pennsylvania Trojan Powder Company, Allentown, Pa.

MR. H. E. HARING, for the last two years in the inspection division of the Ordnance Department, is now connected with the Bureau of Standards where he will be engaged in electrochemical research.

S. T. DANA, forest economist in the Forest Service, has been assigned to the joint congressional committee for the reclassification of salaries to assist in the formulation of a report to the congress.

PROFESSOR J. E. KIRKWOOD, head of the department of botany at the State University of Montana, has been granted leave of absence for the coming academic year. He will spend much of his time in research and study at the University of California.

DR. W. ARMSTRONG PRICE, assistant professor of geology at West Virginia University, has resigned this position to devote full time to his duties as paleontologist of the West Virginia Geological Survey.

CHARLES CONRAD ABBOTT died at Bristol, Pa., on July 27, in the seventy-seventh year of his age. Dr. Abbott was the author of "Primitive Industries" published in the early '70's, and of a number of books on natural history, including the "Archeology of the Delaware Valley."

SAMUEL T. WELLMAN, past-president of the American Society of Mechanical Engineers, well known in the iron and steel industry of the Great Lakes, died on July 11, at the age of seventy-two years.

DR. JOSEPH ZEISLER, professor of dermatology at Northwestern University since 1889, died on September 1.

GEORGE STEPHEN WEST, professor of botany in the University of Birmingham, has died at the age of forty-three years.

DR. J. GÓMEZ OCAÑA, professor of physiology at the University of Madrid, and life senator, has died, aged fifty-nine years.

THE Civil Service Commission of the state of New York will hold examinations on September 27 for the position of assistant director, Division of Laboratories and Research, State Department of Health, with a salary of $4,000. This position is open to men between the ages of thirty and forty-five years and to non-residents and non-citizens. Applicants will be rated on education, experience and personal qualifications. An interview may be required. There will also be an examination for a bacteriologist-pathologist, Division of Laboratories and Research, State Department of Health with a salary of $2,500, open to men and women, twenty-five to forty-five years of age. Candidates will be rated on a written examination relating to the duties of the position, weight 1; and on their education, experience and personal qualifications, weight 1.

HARVARD UNIVERSITY announces that Dr. Thomas M. Legge, chief medical inspector of factories in Great Britain, has been invited to

give a course of Lowell Lectures and the Cutter Lectures in Preventive Medicine for the coming year. These lectures will be given under the auspices of the school of public health of Harvard University, the division of industrial hygiene and the Massachusetts Institute of Technology. Dr. Legge will lecture in Boston on November 18 and ensuing dates upon the following subjects:

"Twenty years' experience of the notification of industrial disease."
"Twelve years' experience of workman's compensation act and industrial diseases."
"Medical supervision in factories."
"Industrial poisons and their prevention."
"Anthrax."
"Fumes and gases."
"Industrial fatigue."
"Industry as a subject for art."
"Manufacture under the medieval trade guilds."

It is stated in *Nature* that a conference of representatives of the Meteorological Services of the British Dominions is to be held in London on September 23–27, when the subjects to be considered will include the meteorological arrangements for the exchange of observations by wireless at comparatively long distances; specification of observations for the surface and the upper air with the codes for transmission; the consideration of instruments and material for the investigation of the upper air; the selection of stations of the "Réseau Mondial" for the purpose of the general climatology of the globe; the provision of current meteorological information for the main air routes of the world; cooperation in the investigation of the meteorological conditions of aerial navigation; and the trade routes and the meteorological survey of the oceans by observations transmitted by radiotelegraphy from ships. The following official meteorologists of the Dominions beyond the seas are expected to be present: Captain A. J. Bamford (director of the Meteorological Service of Ceylon), the Rev. D. C. Bates (director of the Meteorological Office of New Zealand), Mr. H. A. Hunt (director of the Weather Bureau of the Commonwealth of Australia, Melbourne), Mr. H. Knox Shaw (director of the Meteorological Service of the Public Works Ministry, Egypt), Mr. C. Stewart (chief meteorologist of the Union of South Africa), Sir Frederick Stupart (director of the Meteorological Service of Canada), and Dr. G. T. Walker (director-general of Indian Observatories).

The publication of annual or semiannual vital statistics reports was suspended in France during the war. We learn from the *Journal* of the American Medical Association that the *Journal officiel* has now printed the official statistics for 1915, 1916 and 1917 of seventy-seven departments, and the figures for 1913 are given for purposes of comparison. For the seventy-seven departments concerned, the number of births and deaths was as follows:

	Births	Deaths
1913	604,811	587,445
1914	594,222	647,549
1915	387,806	655,146
1916	315,087	607,742
1917	343,310	613,148

These statistics show that while in 1913 the number of births exceeded the number of deaths by 17,366, the deaths in 1917 exceeded the births by 269,838. It should be noted that these statistics do not include the eleven invaded departments in which war was waged for fifty-two months and in which the losses caused by the war were not counted, but which officially have been stated as being 1,400,000 men.

The *Journal* of the American Medical Association states that an elaborate scheme for graduate medical education in Great Britain has been formed, and it is hoped will receive support from the government. Graduate teaching is required for the following classes: (1) physicians in Great Britain who would like to spend a portion of their holidays in getting up to date in all branches of their work, or who wish to spend a few months in learning all that they can about some particular subject in which they desire to specialize, either completely or in conjunction with general practise;

(2) medical officers of the Royal Navy, the Royal Army Corps, the Royal Air Force, and the Indian and Colonial Medical Services, who have to attend postgraduate courses at stated intervals; (3) graduates from British colonies, India and Egypt, including those who have recently qualified, and wish to complete their medical education in England, and some senior men who fall into the same category as the men in Class 1; (4) graduates of allied countries, especially Americans, large numbers of whom have in the past studied in Germany and Austria, in many instances simply because they were unable to obtain equal facilities in England, as well as the French, who have hitherto rarely studied abroad, and the Japanese.

THE Civil List pensions granted by the British government during the year ended March 31 last, includes, as we learn from *Nature,* the following: Mrs. Edith Harrison, in consideration of the services rendered by her late husband, Colonel W. S. Harrison, in connection with inoculation against enteric and typhoid fevers, £50; Mrs. Cash, in view of the contributions of her late husband, George Cash, to the study of Scottish topography, £50; Mr. William Cole, in view of his contributions to the study of natural history and to scientific education, £50; Mrs. R. O. Cunningham, in view of the services of her late husband, Professor Cunningham, as naturalist on board H.M.S. *Nassau* during the survey of the Straits of Magellan and the west coast of Patagonia, and as professor of natural history in Queen's College, Belfast, £50; Mr. Benjamin Harrison, in view of his devotion to scientific work (in addition to his pension of £26 a year), £25; Mrs. E. A. Mettam, in view of the distinction of her late husband, Professor A. E. Mettam, as professor of pathology and bacteriology, and of his contributions to veterinary science, £75; Miss Helen Tichborne, in view of the late Professor Tichborne's scientific discoveries in chemistry and pharmacology, £60; Miss Eliza Standerwick Gregory, in view of her eminent services to botanical science, £60, and Lady Eleanor Charlotte Turner, in view of her late husband, Sir George Turner's services in the investigation and prevention of rinderpest, and in consideration of his death through contracting leprosy in the public service, £50.

UNIVERSITY AND EDUCATIONAL NEWS

BENNO LOEWY, a lawyer, has left the residue of his estate, said to amount to $250,000, in trust to his wife, to revert to Cornell University after her death. He gave his collection of stamps, pamphlets, engravings and illustrations to Cornell for immediate possession.

THE Connecticut state appropriations for the agricultural stations were increased by the last legislature. For the ensuing biennium the State Station will receive $45,000, an increase of $7,500, and the Storrs Station $25,000, an increase of $10,000.

DR. EDWARD G. BORING, recently of Cornell University, has been appointed professor of experimental psychology and head of the psychological laboratory at Clark University, to succeed the late Professor Baird. The staff of the department of experimental psychology will consist of Professor Boring, Professor Samuel W. Fernberger and Mr. Carroll D. Pratt.

THE department of forestry in Colorado College, which was suspended for the period of the war, is being revived under the charge of Mr. Gordon Parker, M.F. (Harvard), who has had charge of the Montezuma National Forest as supervisor for the past five years.

DR. HERMAN L. IBSEN, formerly connected with the University of Wisconsin, has been appointed assistant professor of animal genetics at the Kansas Agricultural College.

W. S. NELMS, Ph.D. (Columbia, '13), has been elected associate professor of physics, in charge of the department, of Emory University, in Atlanta, Georgia. He has been recently discharged from the army in which he was a first lieutenant in the technical staff of the Ordnance Department.

Dr. L. Bauman, formerly assistant professor of medicine and director of research, at the University of Iowa has been appointed associate in medicine at Columbia University and assistant visiting physician to the Presbyterian Hospital.

The following appointments to professorships in the University College of Wales, Aberystwyth, have been made: Professor G. Owen, of the University of New Zealand, in physics; Professor W. H. Young, of the University of Liverpool, in mathematics; A. E. Jones, of the University of Wales, in agriculture; Captain W. T. Pugh, in geology.

DISCUSSION AND CORRESPONDENCE

A POSSIBLE SOURCE OF COSMICAL ENERGY

According to the theory of J. J. Thomson, atoms are complex structures of systems of positively and negatively charged particles (such as, *e. g.*, helium nuclei and electrons) in rapid rotation and held in position by an equilibrium of their mutual forces.

Various phenomena can be explained and a possible source of cosmical energy be found by the simple assumption that some constituents of the subatomic structure retard their speed in eons and thereby increase the weight of the atoms.

It was recently pointed out[1] that the different atomic weights of the isotopes, such as, *e. g.*, the different forms of lead, may be due to "age" of the chemical elements, whereby the different types of atoms are subject to a chemical evolution. In the case of lead the radioactive or young lead possesses the lower atomic weight and density than the common or old lead. According to this hypothesis the radioactive, that is newly formed, lead will eons hence have a higher atomic weight and density, while the common or old lead had eons ago a lower atomic weight and density. All other elements should be subject to this aging process, and by the catching of further electrons and helium nuclei transmute into elements of higher atomic weight. Evidence of this is seen in the occurrence of the chemical elements and their distribution upon the earth's surface, where elements of the same period are mostly aggregated in definite mineral types.

[1] Science, 49, 328, 1919.

Assuming that the orbital motion of the electrons is lessened in a certain time interval, it is evident that a steady and continuous amount of energy apparently disappears. This energy perhaps reappears as cosmical energy, for the principle of conservation makes it inconceivable that such a steady drainage of energy should be constantly wasted.

If such a theory is substantiated, a link between the extreme sciences of the macrocosmos and microcosmos, astrophysics and subatomic physics, will be established and stellar evolution will be based upon a chemical evolution whereby all types of atoms change until they finally become radioactive, that is unstable, and disintegrate again. The smoke-rings of some planetaries are then perhaps clouds of helium gas formed by the radioactive disintegration of the nuclear star, and would thus indicate the last stage of chemical and stellar evolution and the beginning of a new series.

Ingo W. D. Hackh

Berkeley, Calif.

THE IMPERFECT STAGE OF LEPTOSPHÆRIA TRITICI OF WHEAT

In connection with studies of anthracnose of small grains a species of what seemed to be an *Ascochyta* has frequently been found on dead straw. Recently, while culturing *Leptosphæria tritici* the relationship of these two forms was revealed.

The pycnidial fruiting bodies grow side by side with the perithecia of *L. tritici* on dead wheat straw in the spring and are difficult to distinguish from them, both being dark, submerged and of the same size, though the ostioles of the perithecia are more protruding. The pycnidia are filled with guttulate spores, usually two-celled and approximately 12–20 $\times$ 3.5–4 μ, their shape, size and manner of production suggesting *Ascochyta graminicola* as described by Frank. Single spore cultures of the ascospores of *L. tritici* obtained by the

Hansen method of isolation, produce on potato agar and on sterile straw, pycnidia and pycnospores like those found growing with the perithecia on the wheat plant.

L. W. Durrell
Iowa Agricultural Experiment Station,
Ames, Iowa

SCIENTIFIC BOOKS

A BRIEF SURVEY OF SOME RECENT CHEMICAL LITERATURE

Notwithstanding the extraordinary demands which have been made upon the chemists of this and other countries during the recent years, there has been a considerable number of contributions to chemical literature. It has, however, also been a period in which reviewers were difficult to secure and the editor's table has accordingly been filled with an accumulation of material which the writer has been asked to pass in brief review. He has regretfully to confess to responsibility for a further considerable delay in the accomplishment of the undertaking. As a result, a number of the titles mentioned below will be recognized as already familiar; but it may, nevertheless, be useful to recall them.

In the field of inorganic chemistry Alexander Smith's "Inorganic Chemistry" (The Century Co.) has appeared in its third edition, in which the well-known character of that work is strictly maintained, the changes being chiefly those of amplification. Other standard texts which have recently appeared in revised form are: Holleman-Cooper's "Text-book of Inorganic Chemistry" (5th edition, John Wiley & Sons); Newell's "Inorganic Chemistry for Colleges" (D. C. Heath & Co., 2d edition), and Cady's "Inorganic Chemistry," which has appeared in a simplified form, under the title "General Chemistry" (McGraw-Hill Book Co.). In none of these has there been any marked change in the manner in which the subject is treated. Professor H. G. Byers, of the University of Washington, has contributed an interesting new volume ("Inorganic Chemistry," Charles Scribner's Son's) which is more or less frankly constructed along the lines of Alexander Smith's texts, and, in scope, lies between his "College Chemistry" and the larger work mentioned above. It is rather a pity that the publishers saw fit to dress this material in a garb so exactly like that of Professor Smith's books that, in appearance of the printed page, the books are indistinguishable, which creates an unwarranted impression of reproduction of material, in view of the general similarity of treatment.

In the "Principles of Chemistry" of Dr. Joel H. Hildebrand (The Macmillan Co.) there is to be found a volume which has real freshness and originality of treatment of its subject matter. With a minimum of descriptive matter, for which the student is referred to existing texts, the fundamental concepts are clearly stated and well illustrated for beginners. The book contains much for the consideration of thoughtful teachers.

Two texts for secondary schools are to be found in the editor's collection, one by Dr. B. W. McFarland, of New Haven ("A Practical Elementary Chemistry," Charles Scribner's Sons), which presents a thoughtfully arranged course of instruction in which the laboratory forms the central feature, and another by Charles E. Dull, of Newark ("Essentials of Chemistry," Henry Holt & Co.), which has appeared since the beginning of the war and in which particular stress is laid on the importance of the science, through the use, as examples, of the chemistry of common things.

Laboratory manuals to accompany the texts of Newell and of Byers have been issued by the publishers of these texts; also one to accompany the well-known text-book of McPherson and Henderson (Ginn & Co.). Other manuals by W. A. Noyes and B. S. Hopkins (Henry Holt & Co.), W. J. Hale (The Macmillan Co.) and W. M. Blanchard (D. Van Nostrand Co.) make no reference to any specific text. All of these manuals are carefully prepared, and while each has some particular points of excellence, the material is presented along well-recognized lines. The "Laboratory Study of Chemistry," by H. R.

Smith and H. M. Mess (Henry Holt & Co.), on the other hand, is out of the ordinary. The authors combine with the directions for experimentation a large amount of interesting information, much of which is not to be found in the ordinary text-books, but which should serve to awaken scientific curiosity and stimulate interest in the work itself. The scheme of instruction as laid down is exacting and calls for teaching of a high order. Whether or not one cares to adopt the procedure as a whole, the book will be found to be full of helpful suggestions and well worth study.

In the field of organic chemistry, the well-known "Organic Chemistry for Advanced Students" of Professor J. B. Cohen (Longmans, Green & Co.) appears in a second edition, in which the material formerly included in two volumes is divided into three, dealing, respectively. with "Reactions," "Structure" and "Synthesis," with the purpose of grouping together to better advantage allied subjects and affording a more logical sequence. The rearrangement of the subject matter has given opportunity to bring the material up to date, and the new volumes seem to fully maintain the standard of the earlier edition as one of the notable works on organic chemistry. The book is written for advanced students and is not designed to have the sort of completeness which belongs to a work of reference, although these volumes will be found valuable in that respect as well. Professor Cohen had also prepared somewhat earlier a "Class-book of Organic Chemistry" (The Macmillan Co.) designed for medical students, and others who are not intending to make chemistry a profession, which merits attention as a carefully planned and simplified course.

Professor J. T. Stoddard's "Introduction to Organic Chemistry" (P. Blakiston's Son & Co.) has appeared in a second edition and Professor E. P. Cook has prepared a little manual entitled "Laboratory Experiments in Organic Chemistry" to accompany it. Both are characterized by a simplicity and directness of statement which is welcomed by beginners.

Among the text-books on analytical chemistry which have appeared during the last few years are to be found several new editions of well-known works. These include a fourth English edition of Treadwell-Hall's "Analytical Chemistry, Volume II., Qualitative Analysis" (John Wiley & Sons), a standard authority; a sixth edition of A. A. Noyes' "Qualitative Analysis" (The Macmillan Co.), a manual based upon what is, perhaps, the most painstaking and thorough series of investigations ever undertaken as a background for the perfection of analytical procedures; and a second edition of Mahin's "Quantitative Analysis" (McGraw-Hill Book Co.), a manual which has already received deserved recognition. A less familiar manual which is in its second edition is that by Edmund Knecht and Eva Hibbert, entitled "New Reduction Methods in Volumetric Analysis" (Longmans, Green & Co.). It is of the nature of a monograph, dealing almost wholly with the applications of titanous chloride as a quantitative reducing agent. Other recent works in their first editions include an "Elementary Qualitative Analysis" by Professors Dales and Barnebey (John Wiley & Sons), a straightforward presentation of the subject, but without striking features; "Methods in Metallurgical Analysis," by Professor C. H. White, a work of somewhat uneven merit (D. Van Nostrand Co.); "An Advanced Course in Quantitative Analysis," by Professor Henry Fay (John Wiley & Sons), another manual based upon a long series of investigations; and a "Volumetric Analysis," by A. J. Berry (Cambridge University Press, England), a manual prepared for a college course in analytical chemistry, in which the general discussion of the subject appears to excel the directions for analysis.

Teachers of stoichiometry are already familiar with Dr. R. H. Ashley's "Chemical Calculations" (D. Van Nostrand Co.), of which a second edition has recently appeared. Errors have been corrected, but no change has been made in the subject matter.

Along the lines of what is commonly known as physical chemistry, the editor's collection

included the following: "Outlines of Theoretical Chemistry," by Dr. F. H. Getman (John Wiley & Sons), which is in its second edition and has been revised and enlarged, notably with respect to atomic structure, colloids, electromotive and photochemistry which has, no doubt, added to the usefulness of a work already respected. The literature relating to colloids has been extended by a second edition of Dr. M. H. Fischer's translation of Wolfgang Ostwald's "Handbook of Colloid-Chemistry" (P. Blakiston's Son & Co.), to which "Notes" have been added by Emil Hatschek, but without essential change in the nature of the material. A further new work is that entitled "The Chemistry of Colloids," by Dr. E. B. Spear (John Wiley & Sons), Part I. of which is a translation of Zsigmondy's "Kolloidchemie," and Part II. is on "Industrial Colloidal Chemistry," written by Dr. Spear, with a chapter on "Colloidal Chemistry and Sanitation," by Dr. J. F. Norton. The subject is brought up to date in an easily readable fashion and is of interest to both the general and technical reader. Dr. F. P. Venable in his "Brief Account of Radio-activity" (D. C. Heath & Co.) has contributed in about fifty pages an entertaining and somewhat popularized summary of the phenomena of radioactivity and their influence upon our notions of atomic structure.

The editor's table contained but one volume on industrial chemistry, now become familiar, namely, Dr. Allen Roger's "Elements of Industrial Chemistry" (D. Van Nostrand Co.), an abridgment of the larger work by Rogers and Aubert. Both have an established place in chemical literature.

The fact that Dr. Phillip B. Hawk's "Practical Physiological Chemistry" (P. Blakiston's Son & Co.) has reached its sixth edition is sufficient evidence of its usefulness in "schools of medicine and science" for which it was written. The entire work has been revised and brought up to date.

"The Chemistry of Farm Practice," by T. E. Keitt, which is included in the Wiley Technical Series, has for its purpose the imparting of a "knowledge of the fundamental chemistry required for intelligent agriculture" and its applications to the art and to the problems of the agriculturist. The story is told in non-technical language. In the same field there has appeared a "Laboratory Manual of Agricultural Chemistry" by Hedges and Boyant which is apparently a useful little book for agricultural institutions, although open to some criticism as to the accuracy of some of its methods for the standardization of volumetric solutions.

A distinct contribution to contemporary literature is to be found in Dr. F. J. Moore's "History of Chemistry" (McGraw-Hill Book Co.). a volume which holds the interest alike of the layman and the scientist, and deals with its subject in a scholarly fashion.

In line with the current effort to supplant German reference works by English equivalents, "The Chemist's Year Book" for 1918–1919, edited by F. W. Atack (Sherratt & Hughes, London), is worthy of note. The present is the fourth edition of this work and is the result of a thorough revision of the last edition. It seems to deserve a place in all laboratories and libraries.

Finally, and again in line with the trend of the times, is a volume entitled "Chemical French" by Dr. Maurice L. Dolt (Chemical Publishing Co.). The author seeks to enable students who have little or no previous knowledge of French to read chemical literature in that language through the medium of this volume and, accordingly, includes instruction in grammar in the earlier portions. The latter portion is devoted to selections from standard and current journal literature. The book contains 398 pages, a length which seems to be somewhat out of proportion in an auxiliary work of this sort; otherwise it is likely to render real service.

H. P. Talbot
Massachusetts Institute of Technology,

ORGANIZATION OF THE AMERICAN SECTION OF THE INTERNATIONAL GEOPHYSICAL UNION. II

The first general meeting, for preliminary organization, of the American Section of the

proposed International Geophysical Union, was held in three sessions on June 24 and 25, 1919.

FIRST SESSION

The sad loss sustained by the section in the death of Professor Joseph Barrell was announced by the acting chairman, Mr. Wm. Bowie.

The acting chairman made a brief statement concerning the purpose of the section, and gave a short sketch of the several meetings previously held in connection with founding the section.

The following business was transacted.

It was decided that the officers and members of the section, and of the Provisional Executive Committee, temporarily appointed in the section by the Division of Physical Sciences, and by the Provisional Executive Committee, shall stand and hold office until the meeting of the section for permanent organization after the Brussels conferences, which have been scheduled to begin July 18, 1919.

The section accepted the proposal of the Division of Physical Sciences that it act as the Committee on Geophysics of the division.

The section is concerned with national as well as international problems in geophysics.

For the purpose of accomplishing the objects of the section the Executive Committee is authorized to appoint from time to time special committees to deal with problems of national or international character.

In the permanent organization of the American Section there shall be a chairman, a vice-chairman, a secretary, and an executive committee, of which the three officers mentioned above shall be ex-officio members.

The members of the section who go to the Brussels meeting are constituted a committee, with power to add to its membership, to consider permanent organization of the section. After preparing a plan for organization this committee is to report to a meeting of the section, to be called at the discretion of the acting chairman, for the purpose of perfecting the permanent organization.

A committee of three, consisting of Messrs. Brown, chairman, Hayford and Humphreys, was appointed to make recommendations to the section for increasing its membership by the addition of men of science engaged in geophysical work or work in affiliated subjects, who would strengthen the section and provide cross-connections with various branches of science in which the section is directly interested.

The statements in regard to the past history, present status and scientific purposes of the specified international scientific organizations were presented and accepted.

After a brief discussion it was found to be the sense of the meeting that neutrals should be admitted to the International Geophysical Union.

Attention was called to certain international organizations not previously specified in the discussions of the committee which it was thought desirable to have affiliated with the International Geophysical Union.

The following delegates and alternates recommended for election by the Executive Committee were approved and elected:

Messrs. L. A. Bauer, Wm. Bowie, A. O. Leuschner, G. W. Littlehales, C. F. Marvin, H. F. Reid, H. C. Graves, J. T. Watkins, Captain Edward Simpson, the three latter also being delegates to the London Hydrographic Conference; and as alternates, Messrs. W. J. Humphreys, J. F. Hayford, W. J. Peters.

A report of the Committee on Variation of Latitude, carrying the following recommendations, was approved:

1. That the observations for variation of latitude, their reduction, and their publication be intrusted to the International Astronomical Union.

2. That the continuity of the observations by the present methods at the four international variation of latitude stations, Ukiah, California; Carloforte, Italy; Mizusawa, Japan, and Charjui, Turkestan; be maintained, as far as practicable, and that the matter of utilizing the observations made at other stations be considered.

3. That the question of renewing variation of latitude observations in the southern hemisphere be considered.

4. That, inasmuch as no definite plan can be advanced for defraying the expense of the variation

of latitude work until some international arrangement is formulated, the several nations maintain the stations within their domains, and that some provisional arrangement be made for caring for the records, reductions and publications, pending a permanent organization of the work.

A report of the Committee on Publications, carrying the following recommendation, was approved:

That all *Titles* in geophysical subjects should be printed in *Science Abstracts*, Section A (Physics), probably best under a special, appropriately entitled section, with *abstracts* of all papers suitable for this journal and drawn up in accordance with the procedures uniform in it.

The appointment of Messrs. Michelson, chairman, Chamberlin, Moulton as a Committee on the Investigation of Earth Tides was approved.

The question of the formation of a separate group, or "sub-section," to represent geochemistry was left to the delegation to Brussels.

The section adopted the plan for voting at Brussels which had been adopted by the American Section of the proposed International Astronomical Union, embodied in the following two motions:

Moved: That it be the sense of the section that on questions of policy which come up in Brussels a caucus be held and the delegation vote as a unit. *Adopted.*

Moved: That it is the opinion of the section if the organization of the union does not conflict that votes on technical matters may be cast by delegates designated by the chairman. *Adopted.*

A suggestion presented by letter from Dr. W. F. G. Swann, regarding the position of "terrestrial electricity" in the subdivision of the geophysical field was referred for consideration to the meetings at Brussels.

A report of the Committee on the Investigation of Earth Tides was read, discussed, approved and referred to the delegation for presentation to the Brussels meeting. This report is included here as an appendix.

Messrs. Henry G. Gale and Wm. D. MacMillan were added to the Committee on the Investigation of Earth Tides.

SECOND SESSION

Joint Session with American Section, International Astronomical Union.

The meeting was presided over by Mr. W. W. Campbell, chairman of the American Section, International Astronomical Union.

Dr. R. S. Woodward addressed the meeting on the general aspects of geophysics and its affiliations and subsequently prepared an abstract of his remarks for the use of the delegation at Brussels.

There was a brief general discussion of the functions of the delegation abroad and of the need of guarding as effectively as possible against legislation tending to exclude any legitimate interests from the international organizations.

Mr. Leuschner gave an account of the origin, relationships and functions of the proposed international cooperative efforts, the progress made toward reorganization, and the further effort required.

The chairman of the American delegates, Mr. W. W. Campbell, was formally authorized to call joint meetings of the delegations of the Sections in Astronomy and Geophysics at his discretion.

After discussion of the report of the Committees on the Variation of Latitude, it was stated as the sense of the joint meeting that an international committee to deal with problems of variation of latitude should be formed.

THIRD SESSION

The Committee on Nominations for additional members of the section—Mr. Brown, chairman, presented the following names and these gentlemen were elected: Messrs. C. G. Abbot, L. J. Briggs, A. J. Henry, L. M. Hoskins, C. E. Van Orstrand, J. B. Woodworth; and upon nomination from the floor, Messrs. A. G. Mayor, R. DeC. Ward and W. J. Peters were also elected.

For the guidance of the delegates to Brussels the document entitled "Proposals for the Convention for an International Union of Geophysics—Approved by the Council of the Royal Society," was read by paragraph and article and votes of instruction were taken.

Three specific research projects presented by letter by Mr. R. A. Daly were then considered, which may be briefly entitled: "(1) A Systematic Thermometric Study of the Gulf Stream, (2) Improving of the Deep Sea Thermograph, and (3) Continued Study of the Composition of Volcanic Gases." These were referred to the Executive Committee.

A brief outline of a statement of the problems of seismology was given by Mr. Wood. This document was referred to the delegation to Brussels and to the Executive Committee.

Mr. Bowie read a brief statement on isostasy and its relationships.

Mr. Bigelow made mention of work planned for exploration in the North Atlantic and the desirability of having this undertaking affiliated with the International Geophysical Union.

Mr. Marvin made reference to the need of centralization in the work of meteorological bureaus, and internationally.

HARRY O. WOOD,
Acting Secretary

APPENDIX: REPORT OF THE COMMITTEE ON INVESTIGATION OF EARTH TIDES

To the American Section of the International Geophysical Union:

Your Committee on Earth Tides begs to report as follows:

1. *Recommendation.*—It is recommended that earth-tide experiments be carried out as soon as possible at stations in (1) Pasadena, California; (2) some island in the central Pacific; (3) the interior of Argentine; (4) England; (5) the interior of Africa; and also, if possible, (6) the interior of India; (7) Japan; (8) Italy; and (9) near Hudson's Bay. It is recommended that the method be that employed at Williams Bay, Wis., in 1915–16, and that the experiments extend over a period of one year.

The reason for the recommendation that the experiments be carried out both inland and near the coast is that it is desired to determine and to eliminate the efforts of the ocean tides on the general tidal deformations of the earth. The reason for the recommendation that two stations be in the southern hemisphere, is that it is desired to determine whether or not the two hemispheres of the earth differ in their deep interiors as they do in their surface features.

2. *Results to be Obtained.*—The proposed experiments will determine the magnitudes of the tidal deformations of the earth of various periods from the semi-daily to the semi-annual within about one tenth of one per cent., and will determine the phases of the principal tides within one minute of time. These results are of an order of accuracy that leaves nothing to be desired. It is possible to determine from the magnitudes of the earth tides the stiffness of the earth, considered as a whole, with a corresponding degree of accuracy; and to determine from the phase relations of t[illegible] tides to the tide-raising forces whether the earth yields as a viscous or as an elastic body, or to what extent it is elastico-viscous, to use Sir George Darwin's term.

The foregoing results are deemed important for the following reasons:

(*a*) They give reliable information about hitherto almost unknown properties of the earth.

(*b*) They throw some light on the effects of enormous pressures on the properties of matter.

(*c*) They enable us to determine accurately the present rate of tidal evolution.

(*d*) They give the geologist a secure basis for theories regarding earth deformations, at least at the present time.

(*e*) They have important relations to doctrine of isostasy.

(*f*) They form a necessary preliminary to a complete treatment of ocean tides.

(*g*) They are valuable in connection with theories respecting the origin of the earth.

3. *Cost of Experiments.*—The cost of the installation of the necessary apparatus for the experiments will be about two thousand dollars for each station, and the expenses of maintenance for a year and the securing and measuring of the records will be about four thousand dollars additional. That is, the total cost of each station will be about six thousand dollars.

4. *Type of Apparatus and Personnel.*—It is recommended that all stations use apparatus of identical type, namely, that employed at Williams Bay, Wis., in the second series of experiments of 1915–16. This will insure that all the results will be comparable, at least so far as they depend upon the apparatus.

It is recommended that the experiments be carried out simultaneously, or at least that they largely overlap in time, so that any general seismic or other possible disturbances may not lead to erroneous conclusions respecting differences in the properties of the earth in widely different parts.

It is recommended that the stations be so located, if possible that the greater part of the work of securing and measuring the films may be done by local scientists. On the other hand, it is recommended that the installation of the apparatus be supervised by those who have devised it and had experience with it. It is recommended that all the details of securing the records, measuring the films, and making the calculations be entirely homogeneous and under the supervision of those who have already perfected them.

Committee of the American Section of the International Geophysical Union on Earth Tides,
A. A. MICHELSON, *Chairman*,
F. R. MOULTON,
T. C. CHAMBERLIN

SPECIAL ARTICLES

RESEMBLANCES BETWEEN THE PROPERTIES OF SURFACE-FILMS IN PASSIVE METALS AND IN PROTOPLASM. I

IN my recent comparison of protoplasmic transmission with the transmission of activation in passive metals.[1] I reviewed evidence indicating that in both cases the effect is dependent upon the properties of the thin film of impermeable or protective material formed or deposited at the interface between the metal, or the protoplasm, and the adjoining electrolyte solution. In the passive metal the composition and physical properties of this thin layer are such that it is very readily and rapidly altered or removed by the electrochemical action of the local circuits which appear wherever the film is locally interrupted or its permeability increased beyond a certain limit. The originally continuous and homogeneous film (of oxide or oxygen compound) may thus be removed by electrolytic reduction at the local cathode; a new local circuit is then automatically formed at the boundary between this reduced or activated region (where metallic iron is exposed) and the film-covered or passive area beyond, which forms the cathode of the circuit; a similar process is there repeated; and in this manner the active state is propagated over the whole surface of the metal. Similarly in the living system, *e. g.*, nerve-axone (according to the local action theory of protoplasmic transmission), the surface-film or plasma-membrane is locally altered or interrupted in an analogous manner by the action of the local bioelectric circuit formed between the region of excitation and the resting region beyond; at this latter region, where the current (positive stream) of the circuit passes from the protoplasmic surface to the medium, it produces, primarily through some local process of electrolysis, a change—the critical or excitatory change—in the structure and electromotor properties of the surface-film, this change being apparently associated with an interruption of continuity or increased permeability; a new circuit then arises at the boundary between this newly altered or activated area and the adjacent still unaltered area; and by a repetition of this process at each new active-resting boundary as it is formed, a wave of chemical and physical alteration, associated with a local electrical circuit, travels over the surface of the irritable element. This wave constitutes the excitation-wave, or nerve impulse in the case of the nerve-axone. Since by its very nature this wave is always associated with a local electric current, it produces the effects of electrical stimulation wherever it extends, hence also in the irritable structure, *e. g.*, muscle-cell, at which the axone terminates.

This theory postulates an essential similarity in physicochemical properties and constitution between the surface-films of passive metals and the protoplasmic surface-films or plasma-membranes of the irritable living cells or cell-structures. Certain general resemblances are apparent: both types of film are water-insoluble, are formed by chemical alteration (typically involving oxidation) of the surface-layer of the metal or protoplasm, are impermeable or difficultly permeable to the electrolytes of the adjoining solution, and are subject to ready alteration under the influence of electric currents formed by local action. In consequence of this latter condition such films are often unstable and subject to com-

[1] SCIENCE, N. S., 1918, Vol. 48, p. 51; *cf.* also my general article on "Protoplasmic Transmission," *Scientific Monthly*, 1919, Vol. 8, pp. 456, 552.

plete and rapid dissolution as a result of slight local mechanical and chemical alteration; any interruption of continuity sets up a local circuit and initiates a process of dissolution which may be propagated over the whole surface and result in the complete destruction of the film; many living cells (*e. g.*, blood corpuscles) are thus unstable, as is also the passive state of a metal like iron in most solutions. Accordingly, unless the film is automatically restored whenever it is interrupted, the state of passivity in a metal, such as iron, or of continued life in a living cell, is temporary and never lasts long. A special peculiarity of such systems, however, is that when the passive metal is immersed in a suitable oxidizing solution, or the living cell in its normal medium, the continuity of the film is preserved by an automatic regulatory process of the type just indicated; and under such conditions the passive or the living condition may be a highly stable one. Automatic reversion to the passive or resting condition is in fact the rule in metals or in irritable elements under certain conditions. This peculiarity is an especially important one from the physiological standpoint, and its basis will be further considered below.

If, as the local action theory of stimulation would imply, the control of protoplasmic processes is largely dependent upon the peculiar properties and behavior of surface-films of this type, it is clear that the general physics and chemistry of such films must be a matter of fundamental interest for general physiology. Although the films formed upon metallic surfaces are obviously widely different in their chemical composition from those enclosing irritable living elements like muscle-cells or nerve-fibers, they nevertheless exhibit in their general physical properties, conditions of formation and behavior many close resemblances to the latter. And it is just those properties which both types of film possess in common that determine the most characteristic features of their behavior, in particular their "irritability" and their power of transmitting chemical influence to a distance. These are the properties which are of most general physiological interest, and they are dependent upon simple conditions of a general kind, which are in no way peculiar to living protoplasm but are present in varying degree at all boundary-surfaces across which the transfer of electricity in association with chemical change (electrolysis) can take place.

The surface-film of passive iron is especially suitable for study from the above point of view because of the readiness with which it is formed and its marked sensitivity to mechanical and electrical influences; in these and other respects it exhibits a behavior closely analogous to that of the protoplasmic surface-films of irritable cells and cell-elements. The experiments about to be described have aimed at determining the degree to which these analogies extend to other peculiarities of behavior, and in particular whether definite correspondences exist in regard to the influence of electrolytes and surface-active organic compounds upon the stability and other properties of the film. Both of these classes of compounds have a well-known and characteristic influence on protoplasmic irritability, a property which is undoubtedly dependent upon the state of the surface-films or plasma-membranes of the irritable elements.

Self-conserving Properties of the Film.—An automatic power of repair is a highly characteristic property of protoplasmic surface-films; slight wounds or interruptions of the cell-surface are repaired; more extensive injury frequently leads to a rapid breakdown of the entire cell. The normal return of a living irritable element to the resting state after stimulation, or cell-division, or other change associated with alteration of the plasma-membrane, appears to depend mainly upon this ability to reform the surface-film. In irritable tissues (muscle, nerve) the time required for this restorative process apparently corresponds with the temporarily insensitive or "refractory" period immediately following excitation, whose duration (as is well known to physiologists) is in general briefer the more rapid the response of the tissue to excitation. Rapid response and rapid recovery are thus constantly associated properties of an irritable tissue. A similar automatic restoration of the passivating surface-film after activation

takes place in an iron wire immersed in a strongly oxidizing solution like concentrated nitric acid, and is similarly associated with a return of the original sensitive or *quasi*-irritable properties of the film; this recovery is also attended with a certain delay, analogous to the refractory period of the protoplasmic system. In this automatic return of passivity both the general oxidizing action of the solution and the electrochemical oxidizing influence at the local anodic regions of the metallic surface are factors.

Iron wires which have previously been rendered passive will frequently retain their passivity for an indefinite time, if left undisturbed, in solutions whose oxidizing powers are insufficient to impart passivity to already active wires. This is the case, for example, in solutions of nitric acid of less than 1.2 s.g.; in such solutions passivity remains unaltered for an indefinite time, provided the continuity of the surface-film is not interrupted (by mechanical or other means) over a sufficiently great area. But activity, once it is established, is permanent and the metal dissolves in the acid. As a rule, extensive scraping or vigorous jarring is required to activate mechanically a passive iron wire immersed in 1.2 HNO_3, although different specimens of iron vary in sensitivity. Apparently if the total area of metallic surface which is thus freed from film and exposed to the direct action of the acid is less than a certain critical minimum, the local anodic action quickly reforms the film, and the wire as a whole continues to exhibit passivity. Hence a single scratch with a glass rod may be ineffective, while if several scratches are made simultaneously or close together the total or summated effect may be sufficient for activation. This behavior throws light upon the general nature of summation-effects in film-covered systems of this class, which include living protoplasm as well as passive iron. Destruction of a sufficient area of surface-film is followed by a rapidly propagated wave of activity which destroys the whole film and renders the whole metal active. Thus the physiological distinction between the "local change" and the "propagated disturbance" in irritable tissues, familiar to physiologists from the work of Keith Lucas and others, is exemplified in the behavior of such wires. Any alteration of the film affecting less than a certain critical area fails to propagate itself and involve the whole surface. Apparently the ratio $\frac{\text{active area}}{\text{passive area}}$ must exceed a certain critical minimum if the activating effect is to gain the predominance and involve the whole surface of the metal; otherwise the entire surface resumes the passive state. Local conditions of either passivity or activity are equally capable of spreading; and the final state of the system as a whole depends upon whether the one or the other condition gains the upper hand. The tendency to revert to passivity after local disturbance varies in different metals and in different specimens of the same metal; for example, in nickel (in 1.2 HNO_3) it is much greater than in iron. Hence the local state of the surface at any time is determined by the relative intensity of the two opposed processes, one of which tends to form and the other to destroy the surface-film. A similar statement holds true of the protoplasmic systems; in the maintenance of any living structure constructive or "anabolic" processes are continually at work, which compensate or offset the continually acting destructive processes; this applies to the surface-film as well as to other protoplasmic structures.

Another simple observation, continually repeated in these experiments, indicates still further the active or self-regulating character of the process by which the surface-film of passive iron is preserved intact in an oxidizing solution (*e. g.*, 1.20 HNO_3) in spite of minor disturbances or local alterations in the film. All solutions of chlorides rapidly destroy passivity, at a rate which is approximately proportional to the concentration of the Cl-ions; usually in the wires used in the following experiments an exposure of 8 or 10 seconds to *m*/1200 NaCl or KCl is required to render a passive wire reactive to 1.20 HNO_3. When, however, such a wire is exposed to the salt solution for less than this critical period, *e. g.*, for 6 seconds, and is then dipped momentarily

in 1.20 HNO_3, washed in distilled water, and again placed in the salt solution, it is found that the time now required for activation is not shorter but is essentially the same as before, *i. e.*, 8 to 10 seconds. Evidently the brief exposure to the acid has restored the partly altered film to its original condition. But if the process of alteration in salt solution is allowed to pass the critical stage (with, *e. g.*, 10 seconds exposure) before transfer to the acid, the latter has no passivating action, and the wire continues to react until completely dissolved. This observation shows that the progressive modification which the film undergoes in the salt solution is of a kind which is rapidly and completely reversible if the metal is returned to the acid before a certain critical stage is reached; but after this stage is once passed the whole film breaks down when the wire is replaced in acid and the iron is no longer protected against solution. This behavior resembles that of living cells after transfer from a balanced salt-solution like sea water to a toxic solution like pure $m/2$ NaCl, as shown (*e. g.*) in Osterhout's experiments with *Laminaria;* the cells undergo a progressively injurious modification associated with an alteration in the properties of the plasma-membranes, shown by increasing permeability; this change may be reversed by transfer to the original medium before, but not after, the modification has reached a certain critical stage. Thus the characteristic power, normally possessed by the living plasma-membrane, of preserving intact its continuity and semi-permeability is simulated in a general manner by the behavior of the surface-film of passive iron in dilute nitric acid.

The action of salt-solutions upon those surface-films (influence of nature and concentration of salts, relative rates of action of different salts, antagonisms) will be described more fully in the second part of this article.

RALPH S. LILLIE

SOCIETIES AND ACADEMIES

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE annual meeting of the North Carolina Academy of Science was held at Trinity College, Durham, on May 2 and 3.

The presidential address was given by Dr. E. W. Gudger on "On an extraordinary method of fishing—the use of remora for catching fish and turtles."

The following papers were presented:

Undamped electrical oscillations: C. W. EDWARDS.
A portable printing outfit for the ecologist: Z. P. METCALF.
Sanitation in the south: THORNDIKE SAVILLE.
Some generic distinctions in sponges: H. V. WILSON.
A magnetic paradox: F. N. EDGERTON, JR.
Vegetation in the closing of ponds with special reference to the Kamaplain ponds of Wexford county, Michigan: COLLIER COBB and H. D. HOUSE.
Preliminary studies of the reproduction rate of Copepoda: FANNIE E. VANN.
Deposits of volcanic ash: JOHN E. SMITH (by title).
Asymmetry in the formation of the nervous system in the frog embryo: BLACKWELL MARKHAM.
Recent mosquito control work in North Carolina: R. W. LEIBY.
Reptilian folklore: C. S. BRIMLEY.
New or little known diatoms from Beaufort, North Carolina: J. J. WOLFE.
Some notes on Protozoa:
(a) *Occurrence of Tintinnus serratus Kofoid in Chesapeake Bay.*
(b) *Arcella excavata nov. sp.:* BERT CUNNINGHAM.
The ovary of the Gaff-topsail catfish, Felichthys felis: E. W. GUDGER.
The seventeen-year locust in North Carolina in 1917: Z. P. METCALF.
Our rats, mice and shrews: C. S. BRIMLEY.
The high frequency electric furnace: F. N. EGERTON, JR.
The felsites of Mount Collier: JOHN E. SMITH (by title).
The inland waterway from Boston to Beaufort: COLLIER COBB.
(a) *A new parasitic blue-green alga.*
(b) *Comparison of Rhododendron catawbiense with a form occurring at Chapel Hill:* W. C. COOKER.
Locating invisible objects: C. C. HATLEY.

BERT CUNNINGHAM,
Secretary

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CONTENTS

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A BASIS FOR RECONSTRUCTING BOTANICAL EDUCATION

THE pages of a leading English botanical journal have, for over a year past, in every issue, contained letters and articles discussing botanical reconstruction and the need of it.[1] One of the foremost American universities has recently sent out a questionnaire asking for opinions and suggestions bearing on the reconstruction of general biological instruction within the college; and the National Research Council has invited constructive ideas as to what should be the content of an "intensive" course of study. The same topic is being discussed in addresses and magazine articles in America. Davis has recently called attention to the importance of the question in SCIENCE,[2] as has also Peirce, in his recent address before the San Francisco Bay Section of the Western Society of Naturalists.[3]

But how shall we decide the content of the introductory course? Something more is needed than mere personal opinion based on the peculiar experiences, and idiosyncrasies, and limitations of individuals. The question is larger than the subject of botany, for it includes the broad problems of educational policy and theory. First of all, then, certain basic principles must be formulated and, if possible, agreed upon. It is the aim of this paper to state, and briefly discuss, two or three of these principles.

One might think that, after all that has been said and printed on the subject, one need

[1] "The Reconstruction of Elementary Botanical Teaching," *New Phytologist*, 16, 241–252, December, 1917; 17, each issue, January–December, 1918.

[2] Davis, Bradly Moore, "Botany After the War," SCIENCE, N. S., 48, 514–515, November 22, 1918.

[3] Peirce, George J., "What Kinds of Botany Does the World Need Now?" SCIENCE, N. S., 49, 81–84, January 24, 1919.

hardly refer to the most fundamental question of all—namely, the purpose of education in general; yet every time the content of the curriculum is discussed, it becomes all too evident that many worthy people either do not keep that question clearly in mind, or else they wholly misconceive it. One can not go into details here—the question is too large. At the risk of being trite, it may be categorically asserted that the aim of education is not merely to give information, nor merely to teach somebody how to do something, and especially is the aim of education not confined to preparing young people to get a living, nor (more emphatically) to get a living only by commercial pursuits. This could not be better said than it was by Professor A. Caswell Ellis:[4]

> Certainly they [the laboring classes] must have vocational education to make efficient producers, but they are going to be "producing" only about six or eight hours a day. What preparation is the school to give for the other sixteen or eighteen hours each day and the twenty-four on Sunday?

I think it will hardly be extreme to say that this question is the supreme problem of present-day education. As Professor Ellis continues to say: "If we do not show more intelligent recognition of this problem than we have in the past then the production of isms and impossible Bolshevist dreams during the leisure hours may more than offset the material production of the working hours." And even if the individual is not inclined to be an agitator, or a public menace in any way, he has himself to live with sixteen or eighteen hours a day, and he exerts his conscious or unconscious influence on others whether he will or not; and he may become a member of the local government, or a member of the board of education, or, if worse comes to worst, even a school superintendent, having a large voice in the organization of public education. Certainly it ought to be clear that the public school curriculum, and the content of each subject taught should be determined with such eventualities, as well as with vocational needs, in mind.

Not to dwell unduly on this first point, let us very briefly note that public education should always adapt itself to the needs and ideals of the age, seeking at the same time to help mold and formulate them. In what direction, then, let us ask, is social organization now tending? What is the modern spirit? Well, a new spirit and changed ideals have certainly been developing during the past two or three decades. One of the outward expressions of this fact is the reduction of the hours of labor from twelve a day to nine or eight.

One of the finest expressions of the new spirit is the address of John D. Rockefeller, Jr., before the War Emergency and Reconstruction Conference of the Chamber of Commerce of the United States, at Atlantic City, on December 5, 1918. "Men are rapidly coming to see," said Mr. Rockefeller, "that human life is of infinitely greater value than material wealth;" and "Modern thought is placing less emphasis on material considerations. It is recognizing that the basis of national progress, whether industrial or social, is the health, efficiency, and spiritual development of the people." The fourth article of his proposed industrial creed rightly affirms, "that every man is entitled to an opportunity to earn a living, to fair wages, to reasonable hours of work and proper working conditions, to a decent home, to the opportunity to play, to learn, to worship, and to love, as well as to toil." Every subject in the curriculum, therefore, should, in its introductory course at least, have its content decided with reference to this entire modern ideal.

But, unfortunately, proposals are now being made in some quarters to revise the botanical course of study in exactly the opposite direction, evidently with the idea that the chief purpose of studying the subject is preparation for a vocation. I would not, for a moment, wish to appear to be losing sight of the fact that there is a vocation of botanist, and many vocations depending, in whole or in part, upon a knowledge of botany. What I am objecting to is the tendency to lose sight of every other consideration, and to commercialize or vocationalize every subject from the introductory course to the doctorate thesis. The committee

[4] *Jour. Nat. Inst. Social Sci.*, 4, 135, 1918.

appointed some months ago in England by Mr. Asquith[5] said, none too emphatically: "Practical education is the only foundation on which idealistic achievements can be raised; to neglect the practical ends of education is foolishness; but to recognize no other is to degrade humanity."

In this connection I would like to urge the desirability of offering, in all of our colleges and universities, "cultural courses" in the various sciences, consisting only of illustrated lectures made as fascinating and broadening as possible, and supplemented by assigned readings and discussions. The aim of such courses should be to give those who have not yet decided upon their life work as well as those who have, a scholarly survey of the aims, problems, methods, history, and results of the given science, and a clear idea of its significance for daily life—personal and social. Such courses would have substantial benefits alike for those who took them and for those who gave them, and would undoubtedly be the means of revealing to many the direction in which their life work lies.

In the second place we should never forget that one of the important aims of education is to enable the individual to find himself; and especially important is it to keep this in mind in deciding on the content of introductory courses. They should be made as informing and broadening as possible. The student should be made to feel that the given subject touches his life, and to what extent—that a knowledge of it is of personal significance to him, that it is replete with fascinating unsolved problems, in the solution of some of which he may find his obvious opportunity for a contented and useful life.

And finally we should always remember that the introductory courses should almost never be planned on the sole supposition that the student is to take more advanced courses, but in full recognition of the fact that the first course may be the only one many students will ever take of any particular subject. With this in mind the course should be made as rich as may be in informational, cultural, educational values. If regard is had for these requirements the course ought to prove entirely satisfactory as a preparation for more advanced study.

From this point of view, undue emphasis should not be placed on details of technique, or minor matters of mere information, but on the broad generalizations that appeal to the imagination and challenge one's admiration, enlarge one's vision, and stimulate and illuminate one's thinking. Some glimpse should be given into the history of the subject, some acquaintance, however slight, with the great names of its makers; and especially should there be some introduction to the unsolved problems that continually challenge and beckon the explorer of the dark continents of knowledge. In brief, the introductory course, that *may* prove to be the last, should be so planned as to enrich the student's life as much as possible. If that given subject proves to be his main life interest, such a course will also prove to be a satisfactory introduction to more advanced work.

At this particular time there seems to be a movement for "intensive" short courses of study. This is no doubt a direct outcome from the program of the Students' Army Training Corps, when intensive short courses were made necessary by the exigencies of war. Osborn[6] has called attention to the fact that the view is likely to obtain with the administrators of student curricula that, if intensive courses are effective "in an emergency," they might well be useful at other times. The danger here is in losing sight of why intensive courses are "effective in an emergency." The need in an emergency is action—accomplishment. What is demanded is the possession of knowledge that may be quickly applied to meet the pressing need. To live a life of culture—of deep insight, broad

[5] Report of the Committee to inquire into the position occupied by the study of modern languages, etc. Issued as a White Book. Quoted from the *New Statesman* (London) by *World Wide* (Montreal), August 17, 1918.

[6] Osborn, Herbert, "Zoological Aims and Opportunities," SCIENCE, N. S., 49, 109, January 31, 1919.

outlook, and wide sympathies—may not, at such a time, be an urgent immediate need; nor is preparation for such a life possible under the stress of an emergency calling for the quick, effective solution of pressing practical problems; but in normal times this is one of the most (if not the most) fundamental needs, of society and of individuals alike. A course a study possible under the more leisurely circumstances of normal conditions may be made not only to minister to these larger and deeper requirements of the spirit, but, if properly planned and administered, will at the same time supply the information to be applied under the stress of an unforeseen emergency.

Herein lies the superior advantage of planning our public education, not solely with reference to utilitarian demands, but on a basis of broad culture. If we wish a conspicuous example of the pitiful and deplorable results of a system of public education organized chiefly with a view to securing practical efficiency, at whatever cost, we have only to look at the sorry spectacle of Germany during the past four terrible years. The great world conflict, recently terminated, has emphasized no fact more clearly than the need of pursuing truth for its own sake, as well as for specific ends and results, and of planning our educational programs with a view to having truth taught from the same angle.

As to investigation and instruction in "pure" botany for its own ends—what should be the rational attitude of several odd thousands of wounded soldiers (and their friends and families) whose very lives have been saved because a number of people (misguided and impractical, no doubt, in the eyes of some of their contemporaries) found wholesome pleasure and recreation in studying the structure, ecology and geographical distribution of sphagnum moss, without the slightest thought as to whether that information might ever have any use, except to give them and others intellectual and spiritual satisfaction, to widen a bit the circle of man's intellectual horizon, and to throw some ray of light on the course of plant evolution. Or what should be the attitude of thousands of aviators, the strength of whose aeroplane propeller blades could be insured only by the application of knowledge (of the structure of wood) resting in part upon investigations in pure botany.

The discovery of X-rays was not the result of trying to find a way to see bullets imbedded in human flesh, nor to ascertain the exact condition of hidden bones fractured by shrapnel; they were discovered in the endeavor of certain men of science to find out all they could about electricity, just because they preferred to spend their time that way than otherwise. Similar statements could be made with reference to the discovery of TNT; of the principle of electromagnetic induction, which underlies the telephone, now so vital in war as well as in peace; of the properties of chlorine gas, which made possible the rapid perfection of effective gas masks; of the classification, life history, and ecology of such insignificent objects as mosquitoes, on a knowledge of which is based a vital part of modern sanitary practise, which made it possible to reduce the death rate from disease to 17 per thousand in the present war (A. E. F.), as against *65* per thousand in the American Civil War; of bacteria and the modern science of bacteriology, without which aseptic surgery and antisepsis would be impossible, for Pasteur's early studies of germ life were made in order to demonstrate the fallacy of the current theory of spontaneous generation—or, in other words, to settle a question of pure science.

On the relation of pure to applied science it will be apposite here to quote Pasteur's statement, in his inaugural address as dean of the new Faculté des Sciences, at Lille. He said:

> Without theory practise is but routine born of habit. Theory alone can bring forth and develop the spirit of invention. It is to you specially that it will belong not to share the opinion of those narrow minds who disdain everything in science which has not an immediate application. You know Franklin's charming saying? He was witnessing the first demonstration of a purely scientific discovery, and people round him said: "But what is the use of it?" Franklin answered them: "*What is the use of a new-born child?*" Yes gentlemen, what is the use of a new-born child? And

yet, perhaps, at that tender age, germs already existed in you of the talents which distinguish you! In your baby boys, fragile beings as they are, there are incipient magistrates, scientists, heroes as valiant as those who are now covering themselves with glory under the walls of Sebastopol. And thus, gentlemen, a theoretical discovery has but the merit of its existence: it awakens hope, and that is all. But let it be cultivated, let it grow, and you will see what it will become.

Preparation for war, therefore, as well as preparation for the vocations of peace, is inextricably bound up with the pursuit of pure science—of knowledge for its own sake. What would have been our preparation for the war just over if our educational system during the past generation, had been based on the practise of teaching only the applications of the science of twenty-five or fifty years ago, omitting or even making secondary the exploration of unknown fields in every direction, without continually raising the question of utilitarian values. As it was, the avoidance of that error was only partial, and the result of continual persistence on the part of "impractical" college professors, combating and resisting all manner of pressure and insistence on the pursuit of the practical, to the exclusion of the theoretical and fundamental.

But straight in the face of all this experience, our educators are now confronted with the old demand. Profoundly impressed with the important part played in military operations by the applications of scientific knowledge, many of our civil and military officials, men of business, and even educators of narrower vision are insisting that our science teaching shall be wholly or largely confined to the applied phases of the subject: botany, for example, must be *restricted* to what is called agricultural botany, or to plant pathology, or to preparation for forestry or pharmacy. Let us teach our children how to grow healthy crops; never mind (or make incidental and secondary) investigating and teaching the fundamental principles and concepts which underlie intelligent and successful practise. Such a program not only loses sight of the difference between mere information and education (the essential business of schools), but will ultimately defeat the very purposes which its advocates have at heart, viz., the efficient preparation of the nation to meet the demands of peace and war. It is a striking illustration of the folly of killing the goose that lays the golden eggs, for it is absolutely necessary to teach something besides the applications of science in the schools if we wish to educate successive generations of scientific investigators, and have any science to apply when the need for application arises.

Here also, should be emphasized the urgent need of having our courses of study outlined and administered by men of broad outlook and wide sympathies, as well as of deep insight. so that the program shall not be lopsided, and narrow, and disastrously inadequate as a preparation of young men and women, not only to take their places in the social fabric in times of peace, but to rise fully equipped and prepared to meet any emergency that may arise—whether of war, or pestilence, or crime, or other disaster.

For example, something is certainly wrong when the education of a city superintendent of schools has been such as to render him unable to appreciate the educational values or the social need of any studies except those that happened to interest him in his school days. Of course we must be careful here not to hold the educational system too fully responsible for the shortcomings of its products; creatures of the Almighty *have* been known to come short, in spite of education and favoring environment. It is a serious and disquieting fact to find the value of botany, zoology and general biology as high school studies, really and apparently sincerely called in question, as is now being done in the schools of Greater New York (and possibly also in other cities); especially when the proposition is to supplant them with studies chosen chiefly for their so-called "practical" nature, and from the point of view that the chief function of education is to pass on information, and the chief duty of public education to prepare boys and girls to secure and hold a position.

It was very timely for Professor Osborn, in

the address above cited, to point out the fallacy of basng introductory courses chiefly on one of the various phases of a science, whether the economic or not, to the exclusion of the others. It is breadth of contact that is needed by the pupil, a broad survey of the field, for it is just as true to-day as ever that the fundamental need is a liberal or liberalizing, education—the setting free of the mind and spirit from all that narrows and dwarfs—the correction of intellectual myopia. This is why I like the term *introductory course* better than elementary course. One may give an elementary course in plant physiology, or morphology, or taxonomy, or ecology, but neither of these would be an introduction to the science of botany.

Neither would a course be that dealt only with facts of structure and function, and the various ways in which such knowledge can be turned to commercial advantage, but paid little or no attention to the larger conceptions of interpretation, significance, cause, and spiritual values. It is undoubtedly a general tendency of scientific men to neglect or subordinate those phases of their subject, especially in its educational aspect. This is natural; it is partly because of their tendency to concentrate on facts and percepts, rather than on interpretations and concepts, that they became scientists rather than philosophers. But herein, also, lies in large part the explanation of why, to the non-scientific, the various sciences seem deficient as educational disciplines. To them something of intrinsic and supreme educational importance is lacking.

Now this deficiency is not inherent in the sciences; it is only inherent in many of those who cultivate them, and we have ourselves to blame in large part if school officials of classical training regard the sciences inferior as instruments of a liberal education. A similar deficiency would inhere in language and history, and even in literature if they were organized for school courses from the same point of view as the sciences so commonly are. The solution of this problem is easier and more obvious perhaps for the humanities; but zoology and botany may easily be organized for instruction so as to partake more fully of the qualities that mark the humanities. The main difficulty is that we somehow feel that our problem or duty is to teach somebody botany, rather than to utilize botany as a means of educating men and women. We need never fear that science and the advancement of science will suffer in the least by complete recognition of its function as an educational discipline.

But what then, you ask, is your proposal for an introductory course of study in botany? Professor Peirce, in his address above cited, modestly refrains from answering such a question in definite terms. He is so averse, he states "to anything which may even seem to dictate what intelligent, thoughtful, conscientious students and teachers should do that, even if I had a formula, I should keep it to myself." The present writer is constrained by similar inhibitions, so far as the details of a course are concerned. There is quite probably no one best course, but I feel certain that any course organized on the basis of the considerations to which attention has been called above, will be superior to any course organized in disregard thereto. But whatever its content in detail, it should and must, before it is over, open the eyes and mind of the pupil to those fascinating and liberalizing conceptions which are the finest fruit of scientific research and thought, presenting chiefly such facts as will enable him to consider them with some degree of intelligence. Among others are the conceptions of biogenesis, evolution, nature and theories of inheritance, reproduction and the development and significance of sex, natural selection, the struggle, especially in Darwin's day, for freedom of inquiry, the nature of life, the fundamental relation of plant life to all other life, botany in the service of man, the wonderfully enlightening subject of geographical distribution (in broad outlines), a practical acquaintance with scientific method and what the perfection of that method has meant to mankind as an instrument for the ascertainment of truth in all departments of knowledge, and glimpses, at least, of the history of the subject, not forgetting to empha-

size the fact that our present body of knowledge is the result of arduous, devoted labor, often attended with great personal sacrifice.

For purposes of a liberal education such ideas are vastly more important than mere information concerning economic uses and commercial processes, or the details of structure and function, and the latter, while essential, to a certain degree, as a foundation for the broad concepts above mentioned, should be presented, in the introductory course at least, as a means to the larger end.[7] If such a revelation as a course of this character will give does not prove a stimulus and lure to delve further into botany or general biology, nothing will, and student and teacher alike should feel amply repaid for the discovery that the student must seek his own life work and major interest elsewhere.

C. STUART GAGER
BROOKLYN BOTANIC GARDEN

[7] This is in essential harmony with Professor Davis's more concise statement that the introductory course will "come more and more strongly to stand out as one that attempts nothing more than the grounding of fundamental principles and a selection of information with rather definite reference to its general and practical interests, or its broad philosophical bearing."

THE RETIREMENT OF PROFESSOR EDWARD L. NICHOLS

ONE of the striking events of the Semi-Centennial Celebration of Cornell University—June 19–23—was the "Physics Conference and Reunion in honor of Edward Leamington Nichols upon the completion of thirty-two years service (1887–1919) and his retirement from active duty as head of the Department of Physics."

Briefly stated it consisted of a reunion of teachers and members of the physics seminary during the thirty-two years of his leadership in the department; of a meeting of the seminary—the last at which Professor Nichols should act as official chairman; and finally of a conference to discuss by what methods and through what means the department can be made of the greatest service to the university and to the country.

The reports at the final seminary were upon "Electromagnetic Induction," by Dr. S. J. Barnett; "The Vacuum Tube and the Development of the Wireless Telephone," by Captain Ralph Bown, and "Binaural Hearing and its Application to the Location of Air and Water Craft," by Professor George W. Stewart.

At the conference—presided over by Dr. P. I. Wold, Western Electric Co., New York City—there was a general discussion on physics as a profession, in which the following leading features were dealt with: (1) The demand and opportunities for the physicist; (*a*) in industry; (*b*) in government laboratories and departments and (*c*) in university teaching and research. This discussion was opened by Mr. E. C. Crittenden, of the U. S. Bureau of Standards. (2) The preparation required to meet this demand: (*a*) the undergraduate curriculum; (*b*) graduate training. This discussion was led by Dr. C. H. Sharp, of the Electrical Testing Laboratories, New York, and by Dr. P. G. Nutting, of the Westinghouse Research Laboratory, Pittsburgh, Pa. (3) The function of research in this preparation: (*a*) research by students; (*b*) research by faculty; (*c*) how can conditions for research be improved. Discussion opened by Dr. Wheeler P. Davey, of the General Electric Company, Schenectady, New York. How could a department—indeed the university as a whole—be so efficiently helped as by this method in which her loyal sons who have faced the world and won, come back to tell wherein their college had helped them and wherein greater help could be given to those who are to come after!

One of the pleasantest incidents was the reunion dinner, at which over two hundred and twenty-five of Professor Nichols's old students, colleagues and friends joined in the spirit of a devoted family to show affection and esteem for their retiring leader. The toastmaster was Ernest Merritt, student, colleague and friend, who succeeds Professor Nichols as head of the department. In the greetings given by the toastmaster and in all of the speeches there were three dominant

notes: Profound admiration for the clear mind which has accomplished so much for the university and for science; gratitude for the wisdom with which he has guided the development of the department, for the standards of teaching and research which he advocated and maintained and for the inspiration he breathed into all about him; and greatest of all the personal affection and esteem for their leader, and rejoicing that, freed from teaching and administrative cares, he was to remain with the department to carry on his researches and lend the inspiration of his presence.

The first speaker called upon was the president of the university—President Schurman. He expressed in fitting words the feelings of all of us when he characterized Dr. Nichols as a man who as teacher, administrator and investigator had measured up to the highest standard, and had realized in his department and in the university the ideal college professor, one that a university president rejoices in finding and when found gives him encouragement and support to the limit.

Professor Ernest Fox Nichols sketched for us in broad outlines "A Generation of Physics in America," and showed the rôle that he whom we were honoring had played in that generation, and the mighty impulse forward he had given by founding the *Physical Review*, where American work could be fittingly published, and in aiding the formation of the American Physical Society where the young men especially found encouragement and a scientific home.

In discussing the early years of Professor Nichols's leadership, Mr. Louis B. Marks pointed out how that he had been one of the best possible friends of applied science from the zeal and earnestness with which he advocated and joined in the discovery of science to apply, and how the problem of the illuminating engineer had been helped to get upon a firm foundation by the exposition of the principles of photometry and the establishment of a photometric laboratory in the department of physics. While it was not upon the program, a pleasant incident was the tribute of appreciation brought by Dr. C. H. Sharp, from the Illuminating Engineering Society in recognition of Professor Nichols's work in putting the measurement of light upon a scientific basis. The tribute was election as honorary member of the society—the only other honorary member being Thomas A. Edison.

Besides the address of former members of the physics seminary, Dean Frank Thilly of the College of Arts and Sciences expounded in a pleasant way the skill with which Dr. Nichols had cut red-tape and made the dean's office in that college a really efficient and helpful element in the university; and Professor S. H. Gage welcomed Professor Nichols into the group of the emeriti with the assurance that its freedom for investigation and its privileges made it the happiest group in the whole educational world.

Finally in behalf of the members of the seminary past and present Dr. C. W. Waggoner, presented as a tribute of affection, a beautiful, inscribed silver tea service which up to that time had been hidden under a bank of roses.

All generous minds can understand why Professor Nichols was thus honored when they read his response:

If health permits and life lasts I am coming back (*i. e.*, from Japan) and I hope I may have a few years more, so that with that sort of curiosity which has always animated me I may have the privilege of watching the wheels go round, for that is all I feel I can do or ever have done. It has been delightful—unspeakably delightful—that life which comes from the study of science. What I would like to say, among the thousand things I would like to say and can not, is that you must not be content with the things the generation that is passing away had to be content with. It is for you to do greater things, and more important things than we have ever done. The things are crying to be done, and the world is crying out to have them done. If Cornell is to be what we all hope and believe she is to be, it can only be through the endless strivings of the imagination, through ceaseless labors and great creative art. It can only be by the highest efforts of everybody who has a mind to do anything whatsoever. Then we can look back upon the crude efforts of those who went before and while we

smile, we may at least believe that they looked forward to the things they could not accomplish but which you shall accomplish.

SCIENTIFIC EVENTS

THE JAMES WATT CENTENARY COMMEMORATION AT BIRMINGHAM[1]

THE arrangements for the James Watt centenary commemoration are now practically complete, the general scheme being set forth in a pamphlet issued by the Centenary Committee. The form which the memorial is to take is threefold: (1) To endow a professorship of engineering, to be known as the James Watt chair, at the University of Birmingham, for the promotion of research in the fundamental principles underlying the production of power, and the study of the conservation of the natural sources of energy; (2) to erect a James Watt memorial building to serve as a museum for collecting together examples of the work of James Watt and his contemporaries, Boulton and Murdock, as a meeting place and library for scientific and technical societies, and as a center from which engineers could cooperate in spreading scientific knowledge; and (3) to publish a memorial volume.

The success of the memorial will depend upon the response to the appeal for funds, and we are glad to note that assurances of support have come not only from all parts of the British Isles, but also from France and America. As indicated in our issue of May 15, we attach special importance to the foundation of the James Watt chair of engineering, and we can imagine no better memorial to the great engineer than the creation of a school of research so endowed as to attract both a professor of exceptional ability and also the most brilliant students, of whatever class. Such a scheme would require an endowment on a scale altogether greater than that which is usually associated with chairs in universities, but it should be possible to raise the necessary money—especially with the sympathetic help of America, which of recent years has shown not only a ready appreciation of the value of scientific research, but also a generosity in its endowment which has been more admired than imitated in this country. It must always be remembered that the vital factor in research is the *man*, and every possible inducement should be offered to secure the best men, both as directors and students.

The commemoration ceremonies are to extend over the three days, September 16–18, and the official program includes a garden-party at Watt's house (where his workshop can be seen in the state in which he left it in 1819), and visits to Soho Foundry and two of his engines (one of which, the first pumping engine built for sale by Boulton and Watt in 1776, will be seen at work). A degree congregation is to be held by the university at which honorary degrees will be conferred on distinguished engineers and men of science.

The committee has issued a short pamphlet (by Professor F. W. Burstall) in which an appreciation is given of the salient facts in the life of Watt, and of his epoch-making association with his colleagues Boulton and Murdock.

[1] From *Nature*.

MEETING OF THE SUBCOMMITTEE ON PATHOMETRY OF THE INFLUENZA EPIDEMIC OF THE PUBLIC HEALTH ASSOCIATION

THE Section on Vital Statistics of the American Public Health Association at the Annual Meeting in Chicago in December, 1918, reorganized the Special Committee on Statistical Study of the Influenza Epidemic with three subcommittees on Registration and Tabulation Practise of the Federal Departments (Subcommittee A), the State Departments and Commissions (Subcommittee B) Municipal Boards of Health and of other local Public Heath Agencies (Subcommittee C) and a fourth subcommittee (D) on Pathometry or Mathematical Analysis and Interpretation of the Epidemic.

Subcommittee A, B, C have met at various times and will have data ready for the consideration of subcommittee D at a meeting called for 9:30 A.M., September 19, at Columbia University. Sessions wil follow in the afternoon and on Saturday the twentieth.

The discussions at the preliminary meetings

of the emergency special committee held in Philadelphia last November and in Chicago last December, brought out a rather confusing lack of agreement as to the effects of preventive measures, and of modes of treatment, upon the form of the epidemic wave, and as to the kinds and character of statistical data available. The work and recommendations of the other three registration and tabulation subcommittee will result in bringing before the coming meeting data that are more uniform, and so better adapted to comparative study towards discovering the quantitative relationships which hold in this epidemic and which it holds in common with other epidemics.

Towards having epidemiology take another step or two away from qualitative methods and towards quantitative research, an earnest invitation is hereby extended to members of the medical profession, to physical chemists and biochemists, to bacteriologists, to those interested in mathematical statistics and climatology, and others to attend the meetings on September 19 and 20, at Columbia University, and other meetings to be announced, and to participate freely in the deliberations of the committee. Meanwhile the chairman invites correspondence addressed to Pomona, N. Y.

Professor Svante Arrhenius pointed out in his Tyndall lectures that "physical chemistry allows us to follow quantitatively the influence of temperature and of foreign substances upon these interesting organic products, which are of the greatest importance in industry, in the physiological processes of daily life, and in diseases and their therapy." In the *Proceedings* of the Royal Society of Medicine, May, 1918, Vol. XI., No, 7, pages 85–132, John Brownlee, M.D., director of statistics, medical research committee, develops a theory in which "the organism producing the epidemic loses infecting power according to the law of a monomolecular reaction." Whether fitting curves to Pearsonian types or to those of immuno-chemistry shall lead to statistical light on influenza remains to be seen. These and other questions remain to be discussed by this committee in a spirit of scientific open-minded search for the truth.

CHARLES C. GROVE,
Chairman

THE NEW ENGLAND FEDERATION OF NATURAL HISTORY SOCIETIES

THE fall meeting of the Federation will be held at Fall River on Friday and Saturday, September 26 and 27, with the Fall River Society of Natural History. The meeting will be in the parish house of the First Baptist Church on Pine Street just below Main. Take cars from the depot to Pine Street. For information in regard to hotels or other local matters write to Mr. Norman S. Easton, Fall River.

The Fall River Society will make a large exhibit illustrating the Natural History of the country around the city. Other exhibits are desired from societies and individuals. The exhibition will be open to the public all day Friday and Saturday. Packages may be sent to the parish house in care of the janitor.

Friday evening, September 26, there will be a public meeting at which there will lectures and addresses by several members. Saturday morning there will be excursions into the country for observation and collecting led by local members. Saturday at 2 P.M. there will be a meeting for business, for reports from the societies of the federation and or discussion of the exhibits and the mornings collections.

J. H. EMERTON,
Secretary

30 IPSWICH ST.,
BOSTON, MASS.

THE MARY CLARK THOMPSON MEDAL

THE president of the National Academy of Sciences, on authority of the Council of the Academy, has appointed the following committee to serve as the committee for the award of the Mary Clark Thompson Gold Medal, to be awarded annually for meritorious services in geology and paleontology: John M. Clarke, *Chairman*, Gano Dunn and Henry Fairfield Osborn.

The Academy accepted the gift in the following resolution:

That the gift of ten thousand dollars presented by Mrs. Mary Clark Thompson, the income thereof to be applied to a gold medal of appropriate design to be awarded annually by the National Academy of Sciences for high recognition of exceptional service to geology and paleontology, and the medal to be known as the Mary Clark Thompson Gold Medal, be accepted and that the academy express to Mrs. Thompson its appreciation of her desire to reward those interested in researches in geology and paleontology. (Adopted June 24, 1919.)

The committee is considering a design for the medal.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH AND THE WAR

THE Rockefeller Institute has received the following letter from Merrite W. Ireland, Surgeon-General of the United States Army, commending its war-time activities:

During the war which is now happily past, your institute proved to be one of America's strongholds. I am informed that from the beginning to the end of hostilities the entire institution was placed by you at the disposal of the War Department and that you did work of the greatest value, not alone for the Medical Department but for the Chemical Warfare and Air Service; that your hospital as well as your laboratories became in effect as much a part of the army as the hospitals and laboratories established by the War Department in our cantonments.

I have also been informed that this great work, extending over the whole period of our participation in the war, was paid for entirely out of your own funds, and was without further support from the government than the routine payment of salaries of such members and assistants of the institute as became part of the Medical and Sanitary Corps.

I thank you for your work of patriotism and your generosity in placing so fully at the disposal of the Medical Department your great and productive facilities for research, for teaching, and for the care of the sick.

SCIENTIFIC NOTES AND NEWS

PROFESSOR VITO VOLTERRA, who holds the chair of mathematical physics in the University of Rome and is a member of the Italian Senate, will deliver a series of Hitchcock lectures at the University of California from October 6 to 17. This will be the second series of Hitchcock lectures this semester, Professor W. J. V. Osterhout, of Harvard University, having just completed the first series on the general subject, "Fundamental life processes." Professor Volterra will lecture on "The propagation of electricity" and "Functional equations."

PROFESSOR JAMES H. BREASTED, of the University of Chicago, has sailed for Europe in order to lead an archeological expedition to Egypt and western Asia, for which permission has been granted by the British government. Before leaving Professor Breasted arranged for publication in *The Scientific Monthly* the lectures on the William Ellery Hale foundation entitled "The origins of civilization," which he delivered before the National Academy of Sciences last April.

MAJOR-GENERAL WILLIAM C. GORGAS, formerly Surgeon-General, U. S. Army, who has been investigating the sanitary matters in Central and South America, has, it is reported, offered to assume technical directorship of the sanitation of Guayaquil, Ecuador, provided the money for the work is supplied by the municipality or the republic. At the request of the Peruvian authorities, General Gorgas is about to proceed to Piura, which is infected with yellow fever. He and his party left Guayaquil for Callao on September 1.

THE Duke of Abruzzi has planned an expedition to the upper reaches of the Wady Scebel, a river which, rising in north Italian Somaliland in the outlying spurs of the Abyssinian mountain ranges, joins the Fafan River. He will be accompanied by his aide de camp, Marquis Radicati; a doctor, a photographer, and four naval under-officers who have taken part in his former expeditions.

MR. E. HELLER has charge of an expedition sent by the Smithsonian Institution to South Africa to make collections for the National Museum.

PROFESSOR A. S. HITCHCOCK, systematic agrostologist in the Bureau of Plant Industry, will leave New York for British Guiana, on

September 24. He will study the grasses of that country, returning in about four months. The work will be done in cooperation with the New York Botanical Garden and the Gray Herbarium.

GEORGE B. SHATTUCK has resigned the chair of geology at Vassar College for the purpose of joining an expedition to Africa.

THE Remington Medal, given annually to a member of the American Pharmaceutical Association, who makes the most notable contribution toward the advancement of pharmacy, was awarded to Professor James P. Beal, dean of the college of pharmacy of the University of Illinois, Chicago, at the sixty-seventh annual meeting of the American Pharmaceutical Association held in New York City.

DR. M. E. CONNER, chairman of the Rockefeller Foundation Commission to Guayaquil. Ecuador, was presented with a gold medal, August 11, in recognition of his services in the campaign against yellow fever.

GEORGE R. GREEN has resumed his duties as associate professor of forestry at Pennsylvania State College. Professor Green was employed during the war as wood technologist at the Naval Aircraft Factory in Philadelphia, in charge of all experiments having to do with wood, glues and fabric, supervision of the dry kilns, and the school for inspectors and wood workers.

MR. A. D. GREENLEE, formerly assistant chemist with the food research laboratory, U. S. Bureau of Chemistry, and, during the period of the war, specialist in poultry handling for the same bureau, with office at the Field Station, Indianapolis, Ind., has resigned from this position to become president of the newly organized Greenlee Products Company, at St. Louis.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Redlands, Redlands, California, has completed a campaign for funds for a program of expansion. In excess of $50,000 was raised by popular subscription in the city and a similar sum was secured by subscription outside. In addition to these amounts, special gifts for buildings aggregate $100,000, construction on two of these, a science hall, and a new men's dormitory, to begin during the present summer. The university will also receive a large sum from the Baptist Church Fund.

AT Tufts College a research fellowship has been established for work on the physiological problems in surgery, under the direction of Professor A. H. Ryan, of the department of physiology and Professor F. H. Lahey, of the department of surgery.

THE trustees of the Western Reserve University have voted an increase of twenty per cent. to the salaries of the entire full-time instructing staff of the medical school.

DR. EMIL GOETSCH, associate professor of surgery in Johns Hopkins University, has been appointed professor of surgery at the Long Island College Hospital, Brooklyn, N. Y.

PROFESSOR E. I. TERRY, for some time connected with the Colorado School of Forestry, has been appointed professor of forestry at Middlebury College, Vermont. He will be supervisor of the 25,000 acres of forest land recently bequeathed to the institution.

DR. E. J. MOORE, associate professor of physics in Oberlin College, has been appointed professor in charge of physics at the University of Buffalo.

DR. J. F. DASHIELL, assistant professor of psychology in Oberlin College, has been appointed associate professor in charge of psychology in the University of North Carolina, succeeding in that capacity the president elect, Dr. H. W. Chase.

MISS GRACE MACLEOD, assistant editor of the *Journal of Industrial and Engineering Chemistry,* has resigned in order to accept the position of instructor in the department of nutrition and food economics in Teachers College, Columbia University.

DR. J. K. SHAW has resigned as pomologist in the Massachusetts Experiment Station in

order to accept the professorship of horticulture in West Virginia University.

L. R. HESLER, assistant professor of plant pathology in the New York State College of Agriculture at Cornell University, has been appointed professor of botany and head of the department of botany at the University of Tennessee.

NEW appointments in Colorado College include in biology: R. J. Gilmore, Ph.D. (Cornell), professor; A. E. Lambert, Ph.D. (Dartmouth), assistant professor, and Florence Brumback, instructor. In chemistry: F. W. Douglas, Ph.D. (Cornell), of Albion College, associate professor. In philosophy and psychology, A. E. Davies, Ph.D. (Yale), recently professor of philosophy in Ohio State University, professor.

AT the University of North Dakota Howard E. Simpson, associate professor of geology and physiography, has been promoted to a professorship of geographic geology, and Leonard P. Dove, now instructor in geology at Northwestern University, has been appointed assistant professor of geology.

AT the Michigan Agricultural College Mr. C. W. Bennett, graduate assistant in botany, has been appointed instructor to succeed Miss Rose M. Taylor, who died last December. Mr. H. C. Young, absent for a year on leave on account of military service as lieutenant in the Sanitary Corps, has resumed his position as research associate in plant physiology.

MME. CURIE has been appointed professor of radiology in the Warsaw University.

DISCUSSION AND CORRESPONDENCE

OPISTHOTONOS

PAST events can only be interpreted in the light of recent phenomena, and to this rule, first so clearly outlined by Sir Charles Lyell, the writer[1] was adhering when he proposed the interpretation that the attitude of fossil vertebrates often suggested spastic distress and induced an inquiry into the causes of their death. Bashford Dean[2] especially has criticized this interpretation and suggested an alternative, voicing not only his sentiments, but the sentiments of the large majority of paleontologists, for on a recent trip through the east the writer found many of them opposed to this interpretation. The causes for this opposition were puzzling in the extreme until it was learned that one chief cause was that *opisthotonos* is regarded as a phenomenon restricted to the human race, and on rereading my paper I find I owe my readers an apology. It now becomes necessary to say that the phenomena, *opisthotonos, pleurothotonos* and *emprosthotonos* are extremely common among modern vertebrates of all classes, and these phenomena are so commonly seen in medical laboratories as to be well known to sophomore medical students. Captain Weed told me that cats inoculated with cerebrospinal meningitis often died during the night in the opisthotonic position and were found fixed in this attitude by the *rigor mortis*. Rabbits, guinea pigs, dogs, frogs and other laboratory animals frequently exhibit the phenomena. The phenomena occur among modern vertebrates in the order of frequency named as they do also among fossil vertebrates. It was the similarity of these occurrences which first suggested that these phenomena *might* indicate disease among fossil vertebrates.

Dr. Dean is quite right in saying:

> It would trouble one to find recorded cases of it (opisthotonos) in reptiles or birds, amphibia or fishes: even in mammals collectively the percentage of deaths following opisthotonos would evidently be microscopically small.

There is no medical literature bearing on this problem, partly because the phenomena are so commonly seen that medical writers have not deemed it worth while. However, Cushny in his text-book of pharmacology has figured a rabbit in opisthotonos, and most medical works on nervous diseases mention the phenomena, but to date none have discussed it.

It is difficult to see the logic of Dr. Dean's reasoning that the pull of the ligaments in dry-

[1] *Am. Naturalist*, LII., pp. 369–394.

[2] SCIENCE, N. S., XLIX., No. 1267, pp. 357, 1919.

ing or decaying would produce this position. We know first of all that the pull is exerted by the muscles and tendons, and the reason why opisthotonos is the more commonly seen is that the muscles of the neck are strongest. In this spastic condition all the muscles of the body are intensely contracted and the more powerful muscles overcome the resistance of the weaker ones. It is interesting to observe in this connection that in the arm muscles of the male frog the pull of the strong flexors, used in the mating season for retaining the female, overcome the extensors and flex the arms into the attitude of embracing, while in the female frog the extensors overcome the flexors and the arms stick out straight, while in a spastic condition. Occasionally, however, as in pleurothotonos, the lateral muscles overcome the dorsal ones. Secondly the ligaments of the vertebral column are but slightly elastic, and I am sure it would puzzle Dr. Dean to furnish examples of opisthotonos caused by the action of the ligaments. If the ligaments did cause this phenomenon then the head should be pulled the other way, for the ventral ligaments drying first would overpower the dorsal ones. Sheep, cattle and horses are commonly seen dead in this position on the western plains, but no one can prove that the drying or rotting of the ligaments caused the attitude, while it is easily and daily proven that they died in a spastic condition, in opisthotonos.

Opisthotonos and its related phenomena can not be rightly regarded as a special form of disease, but rather as a result accompanying many forms of disease and poisoning. The Century Dictionary regards opisthotonos as a malady, but the word malady in medicine is almost meaningless.

Another important phase of the matter and a more difficult one to solve was suggested by Dr. Matthew. Vertebrate fossils are not always figured and studied in the positions in which they died. They are subject to so many disturbing agencies, wind, water and predatory animals, that we can not be sure that the position is really the one in which they died. Often the limbs and parts of the body are shifted in preparing for museum exhibition. On this point, of course, no one can speak with more authority than can Dr. Matthew, but it occurs to me that a sufficient number of animals have been discovered in an undisturbed position to warrant the conclusion that *some* of the vertebrates preserved in the opisthotonos were the victims of disease. The beautiful skeleton of *Steneosaurus bollensis* in the U. S. National Museum, exhibits one of the most interesting examples of this known to the writer.

The point is still open to discussion. We need more evidence from the medical side as to the exact nature of opisthotonos, and from the paleontological side more exact observations by paleontologists of the positions in which the animals are preserved in the rocks. It will be with extreme interest that further discussion on this interesting topic, the antiquity of disease in all its phases, will be read.

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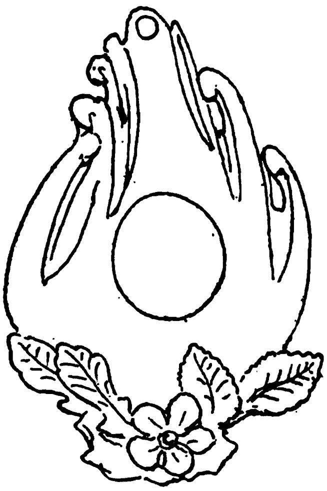
A CHINESE LAMP IN A YUCATAN MOUND

A recent publication of the United States Bureau of Ethnology is a report of Thomas W. F. Gann on the "Maya Indians of Southern Yucatan and Northern British Honduras." Herein is given an interesting account of the people and a description of a series of mounds presenting very curious examples of the ancient Maya pottery and odd-shaped objects of obsidian. In one mound there was found near its surface a soapstone lamp which Mr. Gann recognizes as markedly unlike other objects of Maya fabrication. He says:

> So widely does it differ from Maya standards that there can be but little doubt that it was introduced in post-Columbian days, probably very soon after the conquest. Another explanation which suggests itself is that the lamp was buried in the mound at a much later date (possibly during the troublous times of the Indian rebellions, between 1840 and 1850) by someone who wished to hide it temporarily, and that it had no connection with the original purpose of the mounds.

This latter conjecture is the correct one so far as its age is concerned. It is a modern Chinese lamp made in the vicinity of Canton. I give a rough sketch of one given to me in



1854 when I was a boy, for my cabinet of curiosities. It had been brought from Canton and was probably made by the same artisan who carved the lamp figured by Mr. Gann. In the Peabody Museum at Salem are two lamps of identical character and design. As there were probably no Chinese coolies in Yucatan fifty years ago is it not possible that some one buried the object within recent years to support the contention by some that the culture of Middle America was introduced from China! EDWARD S. MORSE

SALEM, MASS.,
August 27, 1919

QUOTATIONS

INDUSTRIAL FATIGUE AND SCIENTIFIC MANAGEMENT

THE Industrial Fatigue Research Board was appointed at the end of 1917 by the Department of Scientific and Industrial Research to investigate the relations of the hours of labor and other conditions of employment to the production of fatigue having regard both to industrial efficiency and to the preservation of the health of workers. This board has recently issued two reports. One of these, Ethel E. Osborne, M.Sc., on the output of women workers in relation to hours of work in shell-making, arrives at results for which previous investigations have prepared us. The investigations were concerned with the first operation to which the rough forging is subjected; it consists in cutting off the end portion of the forging to reduce it to the required length. It is considered the hardest work in shell-making, must be done rapidly, and entails constant changing of shells. For eighteen months the women doing this in the National Ordnance Factory worked on shifts of twelve hours' duration, with night and day work in alternate weeks. It then became evident that the hours were affecting the women adversely, and the shifts were shortened. Some time previously the machines had been changed to a type which considerably reduced the demands for violent physical exertion. The method in which the investigation was conducted is described at length, but we can only notice the chief general results. Under the earlier scheme the average number of hours worked was 55.85 a week, under the shortened scheme 35.65 a week. On the long hours system the average number of shells each operator turned out in an hour was 8.17; on the shortened shift it was 8.70. Study of the actual fraction of the total working time occupied in the automatic cutting of shells and in their handling respectively—the latter being a period in which speeding up was possible—showed that the work accomplished in 100 minutes of the long hour system was carried out in 80.5 minutes of the short system —a decrease of 19.5 per cent. in time. Taking the average hourly output of shells per hour of actual work as 100, the average hourly output of shells per hour in the factory under the long hour scheme was 85.43, and under the short hour scheme 92.41. The second part of the report is based on a study of actual hourly output; it shows a uniformly low efficiency in the last hour of the long shifts, whereas no such uniformity was to be observed in the case of the short shifts. In some instances there was no falling off at all. A comparison of the records of the same

worker's output for the long and short shifts respectively showed a lower hourly output during the later hours of the long shifts. The investigation afforded no evidence of a detrimental effect of night work in comparison with day work. The second report, by Dr. C. S. Myers, F.R.S., gives an account of a remarkable experiment carried out, with the consent of the workers, by Mr. Vincent Jobson, managing director of the Derwent Foundry Company, Derby. The first step was to analyze the various jobs in order to arrive at the best method, by the elimination of all superfluous movements. This involved the proper arrangement of the tools and materials, the establishment of standard sets of movements for the process, and the training of the men. When the system was not going the number of hours of work was reduced and a special system of payment devised. The result was an enormous increase of output in spite of the reduced hours of work. The increased output, combined with the diminished cost of production, has been beneficial to the firm and largely increased wages of the employees, without causing any increase in fatigue, but rather on the whole, apparently, a decrease.—*British Medical Journal.*

SCIENTIFIC BOOKS

Mortality Statistics of Insured Wage Earners and Their Families. Experience of the Metropolitan Life Insurance Company Industrial Department, 1911 to 1916, in the United States and Canada. By Louis I. Dublin, Ph.D., Statistician, with the collaboration of Edwin W. Kopf and George H. Van Buren. Pp. 397. New York, Metropolitan Life Insurance Company. 1919.

This volume represents a painstaking and well-planned analysis of the 635,449 deaths which have occurred among the industrial policy holders of the Metropolitan Life Insurance Company in the years 1911 to 1916. Because of its great scope and wealth of detail it is of unique value to all who are interested in public health, as well as to physicians in their study of disease. The area covered by the data includes nearly all of the states of the United States and the provinces of Canada. This geographic range is much greater than that of the Registration Area of the United States Bureau of the Census. The report presents a study of the mortality of industrial workers and their families. The data are classified according to color, age and sex. They comprise 54,000,000 years of life, of which 47,000,000 are white and 6,700,000 are black. Thus in addition to a presentation of the mortality experience of industrial workers as a whole, we have here a comparative study of the mortality of whites and blacks of the same economic status. Previous statistical comparisons of white and black mortality compared all whites to all blacks, ignoring their different social status, and the resultant effect of this on disease.

The mortality classification is that of the "International List of Causes of Death." This, while admitting of many imperfections, had to be used in order to render the statistics comparable with those of the Registration Area of the United States Census. The occupational classification follows the "Classified Index to Occupations." U. S. Bureau of the Census, 1910. The material was very carefully compiled, especial attention being given to the avoidance of clerical errors. The diagnoses of death, whenever they were doubtful, were controlled by follow-up letters to the physicians who had certified to the death. This resulted is a greatly increased accuracy of the statistics.

Some of the more important results of this study are worthy of mention. Among whites the mortality of males is much greater than that of females. Among negroes the male mortality is less than the female below the age of 25, with the exception of children from 1 to 4 years of age. After the twenty-fifth year the male mortality exceeds the female mortality, but the excess is moderate compared to that found in whites. Following the presentation of these general considerations, the authors proceed to a detailed analysis of the principal causes of death, giving the rates for the two races in the different age groups and sexes, as well as a comparison of the Metro-

politan mortality with that of the Registration Area. Some of the more interesting facts which have been established by this study may be summarized.

The mortality rate for pulmonary tuberculosis of the children of wage earners is not higher than that of children of the general population. This is all the more striking when we consider that about one half of the children in the Registration Area live in rural communities. The decline in the death rate from pulmonary tuberculosis during the years 1911 to 1916 is greater in the insured than in the general population. The mortality from organic heart disease is higher in wage earners than in the population at large, especially during the working ages. This higher rate persists to old age but to a less degree. Contrary to the general belief, there has been no increase in the death rate for organic heart disease in the period 1911 to 1916. Bright's disease too is a more frequent cause of death in the insured.

Accidents rank fifth in the causes of death. How serious this problem still is, and how great the field for prevention is, is shown by a comparison of the statistics of England and Wales with those of the United States. In 1913, that is before the war, the accident mortality for England and Wales for the ages from 35 to 45 was 62.4 per 100,000. In the United States it was 139.6 per 100,000 in the Registration Area and 154.3 per 100,000 in the insured males at the same ages. Industrial policy holders suffer from a higher accident rate at the ages where the occupational factor plays a part, and where too their death works the greatest hardship to their families. There has been little reduction in the accident rates in the six years under study. During the working years the suicide rate of male workers is greater than that of the general population. It is interesting to note that the colored rate is one half of the white rate. However the homicide rate for negro males is seven and a half times as great as for the entire group of insured wage earners. In the age period 25 to 34 it ranks next to pneumonia as a cause of death of negro males.

The study of the diseases incident to pregnancy and the puerperium is of the utmost importance. The statistics are based on the age group 15 to 45, the child-bearing period. In this age period these diseases cause more deaths than any class of disease except pulmonary tuberculosis. The rates are 66.1 per 100,000 for whites, and 82.3 per 100,000 for blacks. Puerperal sepsis caused 43 per cent. of all the deaths, albuminuria and convulsions 26.4 per cent. The figures for the Registration Area are almost the same. There has been some decline in the maternal death rate in the six years under study. The decline in the insured was 10.7 per cent., which was greater than that in the general population. The authors consider this a vindication of the Metropolitan Life Insurance Company's system of visiting nurses. These figures point out a very important field for preventive medicine.

The analysis of the cancer mortality rates for the period 1911 to 1916 is instructive, for it shows how unsafe it is to generalize. The necessity of considering age groups, the sex and race, as well as the site of the cancer, before drawing inferences as to the increase or decrease of cancer mortality is well brought out. The statistics of the Metropolitan Life Insurance Company show no definite increase in cancer mortality in the six years under study.

I have mentioned but a few of the valuable facts brought out in this volume. The authors are to be congratulated on having made an important and unique contribution to the study of the incidence of disease among wage earners, a study which will be of great assistance to all who labor for the prevention of disease, be they doctors, economists or social workers.

Ernst P. Boas

SPECIAL ARTICLES

THE INTERACTION OF GRAVITATING AND RADIANT FORCES[1]

1. *Atmospheric Temperatures.*—These relations are so interesting, not to say perplexing,

[1] Advance note from a Report to the Carnegie Institution of Washington, D. C.

that I venture to give a few typical examples of the information which I have been gathering. I may recall that the observations are made in a very large, dark, damp room, semi-subterranean, in which the temperature variations on the thermograph rarely reach 1° per day. A compensated ball m of about .6 gram, movable on a quartz fiber, is gravitationally attracted by an external kilogram, M, in the given environment. When M is on the right, or on the slightly warmer side of the region, m is deflected toward larger numbers y, of the scale. In the other case, the reading y is in smaller figures. The actual displacement of m is $x = .1455\ y$ in apparatus I; and $x = .0214\ y$ in apparatus II. The needle carrying m (balanced by an opposite m) pointed north-south, the case being on this side of the large central laboratory pier. The basement wall is over 4 meters off on the east, and over 30 inches thick. This therefore receives solar radiation, directly or indirectly, in the morning.

Fig. 1, for instance, shows the direct reading, y of apparatus I, on July 31 and August 1, the mass M being passed alternately form east (larger reading) to west, at intervals of about an hour.

The readings were now averaged per semi-day (A.M. and P.M.) and also per day and an example of results is given in Fig. 2, Δy showing the double amplitude or total excursions of the aperiodic needle, resulting from the combined attraction of gravitational and radiant forces. Δy varies from much below 3 to much above 7, even in the short interval between July 15 and August 4, and in spite of the fact that the laboratory temperature is practically constant. It follows therefore that the ball M and the east wall reciprocate in their radiant exchanges, almost directly, in a way of which the room temperature gives no interpretable account.

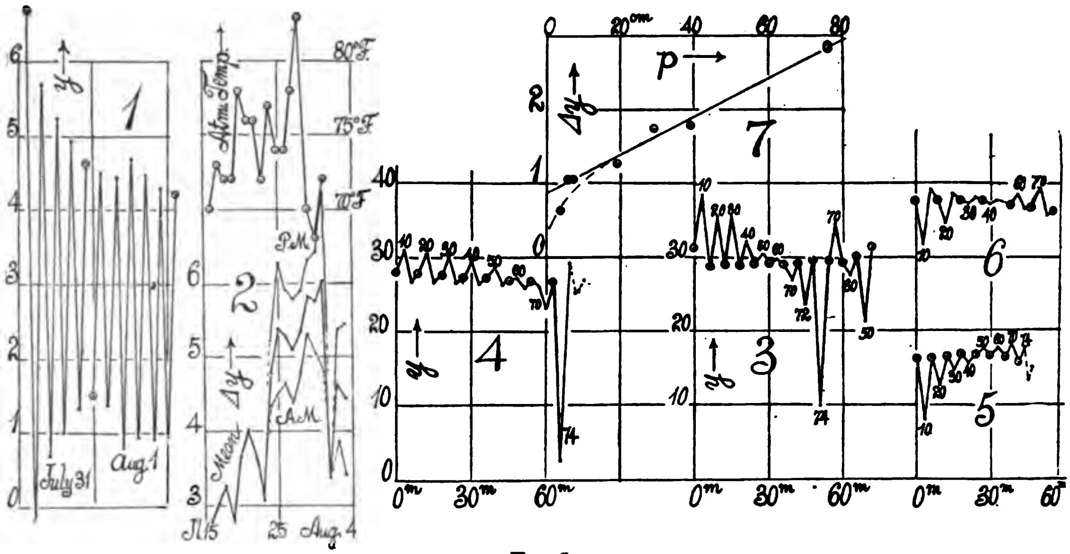


FIG. 1.

On the top of Fig. 2 I have inserted the atmospheric temperatures kindly furnished by Meteorologist Charles S. Wood, of the Providence Station, U. S. W. B. It is obvious at a glance that the two groups of curves, those for Δy and that for external atmospheric temperature are of the same kind; but the Δy curves follow the temperature curve with a lag of one to three days. Whatever radiation falls on the outside of the east wall of the laboratory, shines in a subdued form on the ball M a few days later. In the dark room

one can thus predict what occurred in the outer world several days ago—too bad it is not the other way! But these successive isotherms as they creep through the wall are not given to prophecy. Like our politicians, they have developed a tactile sense and prefer to feel their way.

If we turn again to Fig. 1, it will be noticed that the lower readings for which the ball M is *behind* the case and thus screened from the wall are quite variable, though not usually as much so as the upper readings, in which nothing intervenes between ball and wall. It is thus obvious that the ball parts with what it has absorbed with extreme reluctance. I have therefore been tempted to ask whether with the thermal radiation something else may not have passed which finds in the lead ball so tenacious a receptacle.

2. *Efflux of Air.*—Let me now pass to a different class of experiments given in Figs. 3, 4, 5, 6, in which the ordinates are again scale readings, y, but the periods between them only about 3 minutes. Apparatus *II* with an airtight case is here used and it is exhausted in steps of 10 cm. of mercury each, *very slowly*, but otherwise much after the manner of treating the fog-chamber. Fast exhaustion would throw the readings out of scale and there might be interference from air currents. For this reason pressure increments from influx are here not very trustworthy.

The effect of this efflux is to slightly cool the inside of the case. Thus the ball M, or the environment, is temporarily warmer than the needle m, or the inside. In Fig. 3 (note the small scale) the ball M is discarded and the exhaustions, 0–10, 10–20, . . . 70–72, 72–74 cm., are marked as to the large numbers on the curve. The needle in these experiments was somewhat oblique to the case, the right end being nearer the front window and the left end near the rear. A relatively warmer window if attracting throws the reading into larger numbers. Exhaustion is made when the needle is in an equilibrium position, as indicated by the little circles on the curve. Fig. 3 shows therefore, that the effect of exhaustion is actually a temporary radiant pressure increment on the *cold* side of the needle, the amount of which gradually diminishes until the exhaustion from 60 to 70 cm. (pressures 16 to 6 cm.) has been passed. After this the effect changes sign and the temporary increments now increase with great rapidity on the *warm* side of the needle. A few trials were also made for influx (74–70, 70–60 cm., etc.), in which a total reversal is in evidence, not very smooth, because of the experimental difficulties mentioned.

The ball M was then replaced and put on the far side, so that its attractions (gravity, warmth) would counteract the attraction of the plate glass window. The result of this change of environment is given in Fig. 4. The window (less in mass but nearer) first acts, as before; thereafter the ball M (further but with much more mass) produces an opposed effect. The branches are doubly inflected and the zero points (circles) lower than before, owing to gravitational attraction. Finally the changes of sign of the radiant forces occur as in Fig. 3; but at the high vacua (70–74 cm.), the window effect is absent. Here also the needle begins to show vibration.

The attempt was now made to hang the needle symmetrically to the case, or to the environment, in the absence of the ball M, by twisting the torsion head slightly. Fig. 5 shows that the apparatus is over-corrected. The plenum radiant forces are negative, the vacuum force positive, the change of sign occurs in lower exhaustions (higher pressures) than before, and the radiometer forces are relatively less important.

In the case of Fig. 6 the ball M is restored in a position to counteract the radiant force of Fig 5. Hence Fig. 6 is a reversal of Fig. 4, just as Fig. 5 is of Fig. 3, with the differences just stated.

3. *Influx.*—In conclusion I will adduce an example of a third group of experiments, made in the manner stated in relation to Figs. 1 and 2. In the new experiments the case was exhausted to different pressures, p (cms. of mercury), but left with a slight leak of about

10 cm. per hour at the highest vacua. Hence the air within is permanently slightly *hotter* than the outside, because of the influx. Fig. 7 shows the total excursions or double amplitudes of the mass m, when the ball M is passed from one side to the other of m, in half hour periods. The graph is a little rough because the Δy for the plenum would not be quite constant and the influx can not be perfectly controlled in flow; but the evidence is none the less definite. Conceding that the region between M and m is *cold* relatively to the other side of m, there is always a radiant pressure excess on the cold side of m, increasing nearly at the same rate as the air pressure p decreases. In the high vacua the effect seems even to be accentuated so that gravitational attraction is all but wiped out.

Nothing of the inversion so clearly brought out by Figs. 3 to 6 appears in Fig. 7. In place of it the plenum radiant pressure on the cold side increases steadily, even into vanishing air pressure, p, so far as observed

If one computes the work done by the influx of but 10 cm. per hour, so nearly isothermal, as $Rm\tau \log (p'/p)$ in the usual notation (τ being absolute temperature), it is about the same for all the points of Fig. 7. The case therefore would always be heated alike, within. On the other hand the temperature increment $\Delta\theta$ of the inside air, in the *absence* of all radiation, may by an easy integration be found to be $\Delta\theta = (R\tau/Jk) \log (p'/p)$ and this increases as $\log (p'/p)$, about seven times between the plenum and the high exhaustions;[1] but it is hard to discern how temperature, as such, not considered as an index of the available heat, has anything to do with it, unless there is some other kind of radiation associated with temperature. True, when temperature differences decrease indefinitely, the times of cooling must increase indefinitely; and the meaning of infinity here depends on the delicacy of the instrumentation. But the results thus far do not show whether the temperature effect is absolute or relative and I have not therefore been able to get the mastery of the suspicion that observation of the type of Figs. 1 and 2, made under better conditions, daily, for a period of years, would be worth while.

[1] The temperature increments of the inside air, barring radiation, are 14° at $p = 40$ and about 100° at $p = 7$ cm. What is effective, is the residue, after one half hour's radiation, or more, of this thin air. It seems incredible that such infinitessimals can leave so striking a record as figure 7. In fact, most of the straightforward explanations which I have given for the sake of a cohesive argument, if examined critically, are far from satisfactory.

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THE PHILADELPHIA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fifty-eighth meeting of the American Chemical Society was held in Philadelphia, Pa., from September 2 to 6, 1919, inclusive, the general meeting beginning on the morning of Wednesday, September 3, at the Bellevue-Stratford Hotel.

Local arrangements had been under the charge of the committee headed by George D. Rosengarten and members and guests were bountifully entertained. One thousand six hundred and eighty-seven members and guests registered for the meeting. A considerable additional number of members of the society came from the surrounding cities and towns for special parts of the program but did not register. Fully 2,000 were in attendance.

An interesting innovation of the Philadelphia Section consisted in the daily publication of the *Catalyst*, which is the official bulletin of the Philadelphia and Delaware Sections. This daily paper contained news items, lists of members and guests, the daily programs, reports of various meetings and other entertaining matter.

The general meeting opened with an address of welcome by Honorable Joseph S. McLaughlin, of the city of Pennsylvania, to which President Nichols responded. A large audience completely filling the Ball Room of the Bellevue-Stratford Hotel, listened to the address by Honorable Newton D. Baker, Secretary of War, on "Chemistry in Warfare," and to an address on "Chemistry and the Navy," by Rear Admiral Ralph Earle, chief, Bureau of Ordnance, U. S. Navy. These addresses will be found in the October number of the *Journal of Industrial and Engineering Chemistry*, together with additional details of the Philadelphia meeting.

In the afternoon of Wednesday, the following general papers were presented before the whole society:

1. H. J. Wheeler. Some problems and methods in agricultural research.
2. W. V. Bovie. Some physiological effects produced by radiating definite regions within a single cell.
3. Earle B. Phelps. Stream pollution and its relation to the chemical industries.
4. W. D. Harkins. The building of atoms and the periodic systems.
5. Robert P. Fischelis. The chemical laboratory as a publicity factor.

On Wednesday night the largest smoker ever held by the American Chemical Society at which some 1,300 were present, was enjoyed by all. The program consisted of popular songs, a series of interesting films from the various studios, among others introducing for the first time films showing the growth characteristic of snow crystals; descriptions by Mr. Edward James Cattell, of Philadelphia, interspersed with songs by Henri Scott, of the Metropolitan Company. A special feature of the program was an original play representing early chemists meeting in Philadelphia, being based on the historical fact that the American Philosophical Society gave a dinner to Dr. Joseph Priestly in 1803, at which time Hare's oxhydrogen blowpipe was demonstrated to him opening up a new field of chemical investigation. There were also other interesting features.

The address of President William H. Nichols on "Research and application," given in the Museum of the University of Pennsylvania, on Thursday, September 4, drew a large audience. The address was printed in the issue of SCIENCE for last week.

The banquet held at the Bellevue-Stratford Hotel Friday night was one of the largest held by the society, with its brilliant company, good food and bright after-dinner speeches.

Abstracts of papers presented before the divisions will be printed in SCIENCE.

MEETING OF THE COUNCIL

The council of the American Chemical Society met at the Bellevue-Stratford Hotel, Philadelphia, Pa., 4 P.M., on September 2, with President Nichols in the chair and 97 councilors present.

A. B. Lamb was reelected editor of the *Journal of the American Chemical Society* and the present board of associate editors was continued. Charles H. Herty was reelected editor of the *Journal of Industrial and Engineering Chemistry;* E. J. Crane, editor of *Chemical Abstracts;* Charles L. Parsons, secretary, and B. C. Hesse, a member of committee on national policy for a term of two years.

It was voted that the spring meeting for 1920 be held in St. Louis, and the 1920 fall meeting in Chicago.

The report of the committee on the preparation of a list recommending chemical texts for libraries was presented and accepted.

A committee consisting of Charles Baskerville, F. P. Venable, Julius Stieglitz, W. D. Bancroft and M. T. Bogert, was appointed to draw up resolutions on the death of Lord Rayleigh, an honorary member of our society.

The following by-law having been sent to all members of the council on August 1, was passed unanimously after extended discussion:

> No person shall become a member of any Division who is not a member of the American Chemical Society; but Divisions may have associate members not members of the American Chemical Society who shall be entitled to all the privileges of the Division, save that of voting for officers; provided that such associate members shall not be entitled to any of the other privileges of the American Chemical Society, and shall pay such dues, of not less than two dollars per annum, as the Division may require.

A report of the American delegates to the Inter-allied Chemical Conference held in London, July 14 to 17 and Brussels, July 22, was presented to the council by E. W. Washburn. The substance of this report will be found in the *Journal of Industrial and Engineering Chemistry*, and in SCIENCE.

President Nichols announced that the Army and Navy Departments had responded enthusiastically to the idea that the American Chemical Society furnish certain lectures on chemical subjects to be given at the West Point and Annapolis academies and that he had received a list of the subjects and the individuals which the officials of the academies desired.

Editor E. J. Crane spoke on the plans of the committee on nomenclature, spelling and pronunciation and stated that the committee hoped to take this matter up also with other chemical societies using the English language in the hope that some coordination between them might be obtained. Referring to this matter the following motion was passed:

> That the president of the American Chemical Society invite on behalf of the council of the society the governing bodies of the Chemical Society (London) and the Society of Chemical Industry to appoint a committee, or committees, on nomenclature, spelling and pronunciation to cooperate with the corresponding committee of the American

Society in order to secure as large a measure of agreement in these fields as is practical.

A communication was presented to the council from Munn and Company, New York, in regard to their plans for a development of the *Scientific American Supplement* asking the support and aid of the American Chemical Society in regard to chemical material appearing therein. After extended discussion, the following motion was presented to the council; was laid on the table and was made a special order for the spring meeting:

That as a general policy the society do not lend its name to any private undertaking for profit. This will not preclude contracts with private concerns to carry out undertakings of the society.

It was also voted

That a committee of three be appointed to study the question of possible relations between the American Society and certain scientific publications and report to the next meeting of the council.

The American Chemical Society of a membership of over 13,500 American chemists to-day by its authorized representatives unanimously adopted the following:

WHEREAS, the recent war has clearly demonstrated that the advancement of science through competently directed research in military problems is indispensable to the security of the nation, and

WHEREAS, the bill recently introduced into Congress (Senate 2715, 66 Congress—by the General Staff of the Army providing for universal military service and the reorganization of the Army is of such scope and effect as to inevitably impede the development of all technical and scientific work of the Army by placing it under the absolute control and direction of purely military officers who do not have the requisite scientific knowledge, and

WHEREAS, an organization so constituted could not function efficiently and in time of stress would prove to be an element of fatal weakness and could never hope to ttract to itself those scientific and technical experts without whose aid modern warfare can not be successfully conducted.

Now therefore, be it resolved that the American Chemical Society emphatically protests against this or any other bill which does not provide for commissioning staff officers in the corps and departments in which they are to serve and which does not accord to the technical man the same recognition and opportunity throughout every grade and department of the Army as are accorded to the man trained for a military career only.

The secretary presented to the council a summary of some important matters contained in the bill introduced by the general staff of the Army in the 66th Congress, known as Senate Bill 2715, pointing out that technically trained men were not given the same privileges in the plans for the organization of the War Department which were given to line officers After discussion the following resolutions, prepared by a committee consisting of B. C. Hesse, M. T. Bogert and Charles L. Reese were unanimously passed:

The following resolutions were presented and adopted by the council:

WHEREAS, the American Chemical Society is convinced that the compensation of the chemist in the national and states service, like that of the university investigator in chemistry, is far below that received in the chemical industries, and

WHEREAS, the government can not maintain an efficient chemical service unless it offers adequate compensation to its chemists, and

WHEREAS, various agencies are now at work toward remedying this situation, and

WHEREAS, the Congressional Commission on Reclassification of Federal Employees is one of these agencies,

Be it therefore resolved, that the American Chemical Society hereby pledges its cooperation with Congress and with the Commission of Reclassification of Federal Employees with all other agencies with like endeavor and urges upon them the vital necessity to the welfare of this country of remedying the present situation, and

Be it further resolved, that copies of this resolution be sent to the Commission of Reclassification of Employees, the press, and be published in the *Journal of Industrial and Engineering Chemistry*.

As a result of these resolutions it was voted

That the President appoint a committee of three with power, directing them to cooperate with the Commission of Reclassification of Federal Employees and to furnish them with any available data and to take such action with the commission and other agencies as shall be thought wise in furthering the ends set forth in the resolution.

The president appointed W. D. Bancroft, W. D. Bigelow and Chas. L. Parsons.

It was voted that the secretary send the members of the council copies of resolutions regarding Senate Bill 2715 with a request that they take up same with their senators and congressmen and that they bring the matter also to the attention of other members of their local sections.

CHARLES L. PARSONS,
Secretary

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THE NEW OPPORTUNITY IN SCIENCE[1]

Since I had the good fortune to be somewhat intimately associated with many phases of scientific development work in this country in aid of the war, and also had exceptional opportunity, through reports which came weekly from the scientific attachés in London, Paris and Rome, to become familiar with similar developments in Europe, you will expect me to see the new opportunity in science in situations created by the war or in lessons taught by it. That expectation I shall endeavor not to disappoint. I shall accordingly introduce my subject by a brief review of the most noteworthy features of the methods employed and the results obtained in applying science to the needs of the great war.

That you may be under no misapprehension, however, regarding the importance of the rôle which I myself have played in these events let me begin with an incident of the summer of 1917. It was in the last week in March, 1917, that I gave up my academic duties and was called to Washington as vice-chairman of the National Research Council, charged particularly with the task of assisting in mobilizing the scientific men and the scientific facilities of the United States in aid of the war which was clearly coming, although it had not yet been declared. During the hectic months of the spring of 1917, when the civilian activities in aid of the war were directed by the Council of National Defense in the Munsey Building, I represented the Research Council upon the old Munitions Board and also

[1] A lecture given on July 25 before the summer session of the University of Chicago.

as the representative of the Research Council was appointed by the Secretary of the Navy one of the four advisory members of the Anti-submarine Board, which was the board charged with the direction of the anti-submarine experimenting in the United States. A little later, when it was finally decided that the supply and development work for the American Army was not to be carried on as in England by a civilian organization headed by a minister of munitions, but was to be conducted by the bureaus and corps of the Army itself, like many others who had been intimately associated with the work of the Council of National Defense I was placed inside the Army and given charge of the so-called Science and Research Division of the Signal Corps. I had held this office for about a month and had been passing back and forth in the Munsey Building in a major's uniform, when one morning there appeared in the Washington *Post* an editorial entitled "The Unconquerable Spirit." This editorial was inspired by the appearance of two books, of one of which I had been the unfortunate author, while the other was from the pen of Professor Henry Fairfield Osborn. The one dealt to some extent with the evolution of matter, and the other with the origin and evolution of life on this earth, and the editor having had his attention directed to these two books sat him down and opined about as follows: "Here is a world at war and yet there are found two detached, imperturbable souls, one of whom is still dreaming about the origin of matter and the other about the origin of life, all unconscious of the cataclysmic events which are taking place in the world in which we live." This editorial was penned in the building adjoining that in which I had been going back and forth in soldier clothes for as much as a month and in civilian clothes for three months more. Mrs. Millikan, whose pride was more or less touched by the incident, suggested that the editorial was improperly named, that it should have been entitled not "The Unconquerable Spirit" but "The Contact of the Press with Reality" or "Asleep on the Post." I am sure I should be glad to accept the emendation and I presume Professor Osborn would also, if the editor of the *Post* would agree. But in any event the incident gives an altogether correct picture of the conspicuousness of the rôle which I played in Washington affairs during the period of the war.

A wise man learns even more from his failures than from his successes. One of the most dismal failures of the war was made in the endeavor by all of the principal belligerents to utilize the inventive genius of the *average citizen*. Every major belligerent had a board of inventions and research to which every man with an idea was asked to communicate that idea. All of these boards had precisely the same experience, in England, France, Italy and the United States. They all agree that not one suggestion in ten thousand which came in in this way was of any value whatever, and that the occasional worth-while idea which was presented to these boards was in general arrived at earlier in other ways. It may then be set down as a fact fairly well established by the experiences of the Great War that rapid progress in the application of science to any national need is not to be expected in any country which depends, as most countries have done in the past, simply upon the *undirected* inventive genius of its people to make these applications.

And yet every one of the aforementioned countries actually did make during the war extraordinarily rapid progress in applying new scientific methods to the problems of submarine detection, of aviation, of signalling, of gas warfare, of me-

chanical warfare and of the location of enemy guns, airplanes and mines. How was it done? What was the method adopted to stimulate development in such an extraordinary way as it was stimulated during the Great War? Let me answer by relating a single chapter from our own experience, which is not only representative of all American experience in this field, but is also similar in essential particulars to the experiences of the other countries mentioned.

On March 3, 1917, two days before the United States had declared war, the Military Committee of the National Research Council, consisting of the heads of the principal technical bureaus of the government, both military and civil, and the chairman and vice-chairman of the council, met at the Smithsonian Institution in Washington and dispatched at once a Scientific Mission to Europe to ascertain by first-hand contact and to report back to the United States the exact status at that time of scientific development work in Europe in aid of the war. This mission was received with open arms by the Allies, for it arrived at the darkest hour for France in the history of the war, namely, the hour following the disastrous attempts which General Petain made to push back the German lines in the spring of 1917.

The French government, headed at that time by M. Painlévé, himself a scientist, not only gave the seven scientists, Messrs. Ames, Burgess, Hulett, Williams, Dakin, Reid and Strong, who constituted this mission, opportunity to come into intimate contact with all scientific developments under way or projected at that time, but he arranged to have a return mission, consisting of some of the most eminent of French, British and Italian scientists, such as Majors Fabri and Abraham, le duc de Guiche, and Professor Grignard from France, Sir Ernest Rutherford and Commander Bridge from England, Lieutenant Abetti from Italy, sent back to this country with definite official instructions to hold back nothing, but to lay all the facts and plans of the Allies relating to scientific developments in aid of the war before properly accredited scientific men in the United States.

The National Research Council, which acted as the hosts of this mission in the United States, with authority conferred upon it by the War and Navy Departments, called a conference in Washington of some of the best scientific brains in the United States and for a period of a full week this conference met and discussed in detail the progress thus far made and the plans projected in the fields of submarine detection, of location of guns, airplanes and mines by sound, of ordinance, of signalling, of aviation instruments and accessories, and of chemical warfare.

As a result of these conferences there were organized through the cooperative effort of the National Research Council and several of the bureaus of the Army and Navy, a considerable number of groups of scientific men, each of which was charged with the development of some particular field. For example, Professor Trowbridge, of Princeton, and Professor Lyman, of Harvard, were selected and placed in charge of the development in this country of the sound-ranging service. They and the group of scientific men whom they associated with them were first given commissions in the Signal Corps, and with Signal Corps authority and funds started development work in sound-ranging at Princeton University and at the Bureau of Standards. This whole group was later transferred to the authority of the Engineer Corps, but its directing personnel remained in the main unchanged and it

did extraordinary work in the whole of the fighting of the summer of 1918, locating hundreds of guns by computing the center of the sound wave from observations made on the times of arrival of the wave at from three to seven suitably placed stations. This method had never been used in any preceding war and it proved extraordinarily accurate, a gun being located five miles away with an error of less than fifty feet.

Again it is not an over-statement to say that the most effective of the anti-submarine work done in the United States grew directly out of that conference, and it grew out of it in this way. As Lord Northcliffe continually reiterated on his trip to the United States in the spring of 1917, the submarine problem *was* at that time *the* problem of *the war,* for while Europe might fight with little to eat, it could not fight without iron and oil and other supplies which this country alone could furnish, and in the spring of 1917 civilization trembled in the balance, because the submarine was seriously threatening to destroy all possibilities of transportation from this country to Europe. The English scientists therefore, in particular, came to this country directed by their government to lay before the American scientists every element of the foreign anti-submarine program, whether already accomplished or merely projected, and in the conference under consideration a large part of the discussion centered around the submarine situation. Now the problem of submarine detection, as Sir Ernest Rutherford repeatedly pointed out, was a problem of physics pure and simple. It was not even a problem of engineering at that time, although every physical problem, in general, sooner or later becomes one for the engineer, when the physicist has gone far enough along with his work. Hence, the number of physicists being quite limited, the number of men who had any large capacity for handling the problem of anti-submarine experimentation was small. These men existed mostly in university laboratories or in a very few industrial laboratories which employed physicists, and we unquestionably had gathered a very representative group of them together in the fifty men assembled in the conference at Washington. The success or failure of our anti-submarine campaign, and with it the success or failure of the war so far as we were concerned depended upon selecting and putting upon this job a few men of suitable training and capacity.

At the close of that conference a small committee was appointed to select ten men to give up their work and to go to New London to work there night and day in the development of anti-submarine devices. The men chosen were Merritt of Cornell, Mason of Wisconsin, H. A. Wilson of Rice Institute, Pierce and Bridgman of Harvard, Bumstead, Nichols and Zeleny of Yale, and Michelson of Chicago, although Professor Michelson was almost immediately taken off for other work of much urgency and Chicago was represented in a fashion by the writer who was there a portion of each week. This group worked under the authorization of the Secretary of the Navy and with the heartiest of cooperation from the Navy Department, although it was at first financed by private funds obtained by the National Research Council. In the course of a few months, however, when it had demonstrated its effectiveness it was taken over by the Navy, which spent more than one million dollars on the experimental work at that place. This station with its chief scientific personnel not largely changed became the center of our anti-submarine activity, and with other stations, one at Nahant, Mass., embracing

chiefly the physicists of the General Electric Company, the Western Electric Company and the Submarine Signaling Company, one in New York presided over by Dr. Pupin, of Columbia, and one in San Pedro, Calif., which, like the New York station, was organized under the Research Council, made remarkable progress in the rapid development of anti-submarine devices—devices which exerted a notable influence upon the reduction of submarine depredations, and made it possible even by the fall of 1917, to predict that the submarine menace could be eliminated. Unquestionably the most effective device developed in America, and one which played a real rôle in the elimination of that menace, was one which grew immediately and directly out of the above-mentioned conference. The French had already developed an apparatus consisting of a sort of great sound lens which brought the incoming pulses together in the same phase at the center of the lens near the bottom of the hull. This was presented and discussed at length in the conference. A full official report of the device was sent by the French government to the Anti-submarine Board of the Navy, and at a meeting of that board the writer requested to be allowed to take this report to the group of scientists at New London for the sake of a thorough analysis of it, for he felt confident, and so stated at the time, that through such an analysis we would obtain variants of the device which would be an improvement upon it. This procedure was followed and for two days ten men assembled at a hotel in New London and studied that report, drawing up four or five different variants of this device to develop and try out. The most successful and effective detector which actually got into use in the war was one of these variants of the original French device. Many of our submarines and destroyers which went across during the summer of 1918 were equipped with it, and now it is being still further developed for peace use, rather than for war, for it is possible through it to eliminate the chief terror of the sea, namely collision in fog. And, when it is remembered that the preventing of a single disaster like the sinking of the *Titanic* or of the *Empress of Ireland* more than pays, without any reference to the value of human lives, for all the time and money spent by England, France and the United States combined in developing detecting devices, it will be seen how short-sighted a thing it is for any country to fail to find in some way the funds necessary for carrying on research and development work in underwater detection. For decades and for centuries we have allowed ships to go down year by year needlessly, simply because we have not realized the possibilities of prevention through properly organized scientific research in this field.

But it has not merely been in sound ranging and in submarine detection that the war has demonstrated the capabilities of science. Every single phase of our war activities has told the same story. Turn, for example, to the development of new scientific devices for use with aircraft. How was that handled? The Science and Research Division of the Signal Corps, organized through the cooperation of the Signal Corps and the National Research Council and later transferred to the Bureau of Aircraft Production, had a group of as many as fifty highly trained men, physicists and engineers, who were working in Washington and in the experimental station at Langley Field, twelve hours a day, seven days a week, on aviation problems—one group on improvements in accurate bomb dropping, another on im-

provements in airplane photography, another on the mapping of the highways of the upper air in aid of aviation, another upon balloon problems, such as the development of non-inflammable balloons concerning which you have read in the papers, another on aviation instruments, compasses, speed meters, etc., and producing the best there are in the world, and finally a chemical group on new sources for acetone for airplane coverings, new sensitizing dyes for long wave-length photography, etc. Let me select for special comment but one or two of the seventy odd problems which these groups alone were actively engaged upon at the signing of the armistice.

Throughout the whole of the war bombing was done in a very inaccurate, a very hit-or-miss way. At Langley Field a group of able scientific men were set upon that problem—and there are only a few men in the country who have the requisite training for handling the difficult problems of stabilization which are here involved. That group, headed by Dr. Duff, improved the accuracy in bombing so far as the main error was concerned, which is in the determination of the vertical, by more than three-fold, and when it is remembered that a three-fold increase in the accuracy of placing bombs is exactly the equivalent of a three-fold multiplication of the production of bombing planes, it will be realized how important it is to devote the small funds necessary to get scientific men to solving these problems, and not to confine attention merely to the problems of production.

Or, take again the problem of airplane photography. The developments of the war have completely revolutionized the whole art of surveying, for a camera in an airplane can now take in a few seconds a complete map of any locality, even from a height as great as 25,000 feet. It is only necessary to have a few fixed points on the photograph which are determined by the old triangulation methods and, by simply measuring up the photograph you have all that it used to take years of time to get by the old-time methods. Probably the finest airplane cameras in existence were developed by the American group assigned to that task.

Or, look at the work of the Meteorological Section of the Science and Research Division. It developed long-range propaganda balloons, capable of flying more than one thousand miles in the upper regions of the air where the prevailing winds are practically always from west to east and have speeds of 30, 40, 50 or even 100 miles an hour. It also mapped these upper regions in aid of aviation, an undertaking the importance of which can be seen from the fact that an aviator above the clouds who knows nothing of the direction of the winds will move toward his objective 200 miles an hour faster if he is helped by a 100-mile wind than if he is opposed by it.

These are merely samples of the results which were obtained in extraordinarily rapid time by the group-method of attack upon the scientific problems of the war, and these are merely a few of the developments which came under the writer's immediate attention.

In the Chemical Warfare Service equally rapid and equally important work was done in the development of new gases and in the development of means of absorbing enemy gases in gas masks. I am quite happy to be able to say that Professor Lamb, who was at the head of the Offensive Gas Warfare activity, has assured me that the key to the development of the American gas mask came from the work which Dr. Lemon has for years past been

carrying on at Ryerson Laboratory on the absorption of charcoal. In the Ordnance Department too under the leadership of Professor F. R. Moulton, of our department of astronomy, new methods of computing the trajectories of projectiles were developed in collaboration with the meteorological service, already referred to. New sets of range tables were devised which included corrections for the so-called ballistic wind. Without such corrections which are altogether new in artillery practise, firing by the map, which, in view of the development of long-range guns and camouflage, represents a large fraction of all firing, becomes utterly impossible, for the ballistic wind correction would often make a difference of a half a mile in the point of landing of the projectile. When it is remembered that the biggest element in the effectiveness of a modern army is its artillery, and that the effectiveness in the artillery is dependent entirely upon the accuracy of these wind corrections, it will be seen how incalculably valuable the work of the trained physicist and mathematician has proved to be to the practical problems of modern war.

Do not, however, let me give the impression that our groups in this country have been more successful than have corresponding groups in England and France. The general method of attack has been the same in all these countries, and the experimental groups in them all have functioned as a unit through the development of the so-called Research Information Service, which was financed by a grant of something like $150,000 which the President gave from his emergency fund to the National Research Council for the establishment of four offices, one in Washington, one in London, one in Paris and one in Rome. The office in Washington was headed by a group of three men: the chief of the Army Intelligence Service, the chief of the Navy Intelligence Service, and the chairman of the National Research Council: the group in London by the naval attaché, who is Admiral Simms himself, the military attaché, and a new appointee called the scientific attaché, chosen by the National Research Council. The function of the scientific attaché in England was to keep in touch with all research activity in that country and to send back almost daily reports to our office in Washington. Similarly, all reports of work done on this side were sent by uncensored mail or by cable to the offices of the scientific attachés in London, Paris and Rome and distributed from there to the research groups in Europe. At the request of the General Staff, the Secretary of War issued orders to all army officers who were sent on scientific and technical missions to make duplicate reports, one to the officer who sent them and the other to the office of the scientific attaché, so that there might be a central agency through which an interconnection might be had between all kinds of new developments.

Furthermore, through the authority conferred by the Military Committee of the National Research Council, embracing the heads of the technical bureaus of the Army and Navy, Admirals Benson, Griffin, Earl Taylor and Generals Williams, Squier, Black and Gorgas, there was held in Washington at the office of the National Research Council a weekly conference which reviewed all the reports from abroad each week and put the workers on this side into the closest touch with the developments on the other side. The whole plan was an admirable illustration of the possibilities of international cooperation in research. In the submarine field, for example, all anti-submarine work in England, France and Italy which was reported by cable and

by uncensored mail immediately to the office of the Research Council in Washington, was taken each Saturday night to New London and presented in digested form to the group of scientists which was working there continuously on submarine problems. Similar arrangements were made with the aeroplane research groups, sound ranging groups, etc., so that in the Research Information Service we had the first demonstration in history of the possibilities of international cooperation in research on a huge scale, a sort of cooperation which made it possible for any develment, or any idea which originated in any of the chief civilized countries of the world to go at once, very frequently by cable, to all the other countries and to be applied there as soon as possible, or to stimulate carefully selected groups of competent technical men in these countries to further development. *The extraordinary rapidity with which scientific developments were made in the war was unquestionably due then, first, to the forming of these highly competent research groups, and second, to the establishment of effective channels for the cooperation between these groups.*

But what have all these accomplishments of science in the war to do with the new opportunity in science? Simply this; for the first time in history the world has been waked up by the war to an appreciation of what science can do. Why have we gone on for hundreds of years wasting millions and hundreds of millions of dollars in collisions between ships? Why have we not years ago in times of peace gone at the problems of under-water detection in the way in which we went at them during the war? Simply because men in authority have been asleep to the possibilities. But now for the moment at least they are awake. How long they will remain awake is problematical. But just now the war has taught our political and industrial leaders what science can do. The war has also taught young soldiers that they need their science for success. Administrative positions in the industries are to-day being filled as never before from the ranks of the technically trained men. The war has taught the prospective officer that he can not hope for promotion unless he has scientific training. The war has taught the manufacturer that he can not hope to keep in the lead of his industry save through the brains of a research group which alone can keep him in the forefront of progress.

As a result of all this there is indeed a new opportunity in every phase and branch of science. There is a new opportunity, first, for science in the secondary schools. I hope, at least, that we are going to have an awakening among our principals, superintendents and educational leaders which will make it possible pretty soon to get consecutive, systematic, thorough work in science in the high schools. This is simply a matter of school *administration* and *organization,* and I hope some time principals and superintendents will wake up to that fact. So long as they continue to do what is called in the service "passing the buck," and put it all up to the teacher of science who is absolutely helpless without them no progress can be made. So long as our elementary science is taught by what I choose to call the pellet method of instruction, by which I mean that the science is split up into yearly or half-yearly doses without antecedents and without consequents, we shall never have worth while training in science in the public schools, no matter what the angle of approach, or what the arrangement of subject-matter. The crying need is not for a reorganization and rearrangement of the subject-matter of science. That has been

done and redone every year for twenty years to no avail and it will continue to be done to no purpose until we get a reorganization of the curriculum which makes it possible for the same group of students to get say three *continuous* years of science. The General Science movement has unquestionably thus far been a step backward, rather than a step forward, for it has intensified the pellet-science evil instead of eliminating it. It is acceptable to principals and superintendents simply because the easy thing from an administrative standpoint is to have no continuous courses at all, and we have in recent years been doing for the most part in our school organization the easy thing instead of the pedagogically sound thing. There is then a new opportunity and a tremendous one for those of us who are connected with the teaching and administration of science in the high school.

Second, there is a new opportunity for the application of science to the industries, for the war has demonstrated in the ways which I have indicated, the effectiveness of work of groups of well-trained scientific men, and the leaders of our industries are awakening to that fact, and they are now forming such research groups. Three large manufacturing establishments have written to me within a month, saying that they were starting departments of physical research in connection with their industry and they wanted highly competent physicists to man those departments. The Ph.D. in physics, if he is a man of ability, is in demand to-day in the industries as he has never been before.

Third, there is a new opportunity for the established scientists in the development of the possibilities of cooperative research among themselves. Most of the work in science in the past has been done by the individual, isolated experimenter. The war has demonstrated the immense advantage of cooperation between research groups even though they be in different countries, and the National Research Council is making vigorous efforts at the present time to open up the possibilities of cooperative research even of an international kind. Under the stimulus of that body there is being formed this week in Brussels a new International Physical Union, a new International Geophysical Union, a new International Astronomical Union, a new International Chemical Union. In this country the Physical Science Division of the National Research Council has divided up the field of physical research into twenty departments, has assigned a group to each department, and has found a way by which we can try out the possibilities of cooperative research in physics, by getting most of the workers in each field together once or twice a year for the sake of comparing notes, analyzing the whole situation, eliminating as far as may be duplication, and starting new work on fields that do not seem to be adequately covered by work already under way, and in general stimulating one another by mutual contact. This, I take it, is one of the great opportunities in science at the present moment, and I anticipate great results from the introduction of this method.

Fourth, there is to-day a new opportunity in science for the young American who is facing the problem as to where his life can be spent on the whole most effectively. It is to be assumed that most men are at bottom altruistic, that most men seek to direct their lives into channels in which they can make them most worth while for the race. I should like to divide all altruistic effort into three great classes:

The first has to do with efforts toward the improvement of the individual characters and lives of men. This is the field

which for thousands of years has been the chief concern of religion, and it is perhaps the most fundamental and most important of all. Its needs and its opportunities are eternal, and no thinking man leaves it out of account. But it is not this field to which I am directing attention to-day.

The second type of effort has to do, in one form or another, with possible and projected changes in the distribution of wealth. In this category are found all efforts toward social rearrangements, and educational reform, brought about either by legal enactment, or by the development of an enlightened public opinion. No man in his senses would belittle this type of effort. The needs are tremendous and every right thinking man bids every worker of this sort godspeed. This is, however, the field in which most of the moot questions exist and in which most of the big mistakes are made. Moreover, this is the field which is always before the public eye, and which absorbs nine tenths of the nations' capacity for discussion in print or on the platform.

But it may after all be questioned whether effort in this field has as good a chance—I had almost said one tenth as good a chance—of effectiveness in contributing to human well-being as has effort in the third field, namely, the field which has to do broadly with the creation of wealth rather than with its distribution. This last is the field of scientific and engineering endeavor; for the scientist is, in the broad sense, a creator of wealth as truly as is the man whose attention is focused on the application of science. Indeed, the scientist is merely the scout, the explorer, who is sent on ahead to discover and open up new leads to nature's gold. His motive may be merely to find out how nature works, but once that knowledge has been gained, man almost always finds a way to apply it to his own ends, so that in a very real sense all scientific effort is directed toward the improvement of human well-being through the creation of more wealth.

Now it goes without saying that it is impossible to distribute more than is created, and where the wealth is once created there is no little evidence that natural processes in the long run do a good deal, at least in democratic countries, toward producing a more or less reasonable distribution. The inequalities and injustices which strike the eye are of much less general significance than the superficial observer realizes. A progressive economist told me the other day that I was probably making an over-estimate when I stated that a complete levelling of all incomes in the United States might possibly increase the income of the average worker by 10 per cent. I am informed by one who is in position to know the facts that such a complete levelling in the telephone industry, for example, could not increase the average income of the wage earner by more than 2 or 3 per cent., and I have been given, from what I consider fairly reliable sources, about the same figures for the steel industry. It is probable that the total possibilities of improvement of conditions through changes in distribution are very limited, while possibilities of improvement through increase in production are incalculable. But whether rough figures and estimates like the foregoing have any value or not, this much may be set down as certain. The present distress in Europe is not due to bad distribution but simply to lack of production. Equally certain it is that no one who visited Europe frequently before the war and came back to this country, as I have often done, with the observation that here one finds in comparison with Europe large comfort, large intelligence, large well-being in the case of the average

man, will claim that the prosperity and comfort of the average American citizen as compared with his European brother is due to a better mode of wealth distribution which is in use in this country. Our critics claim that we have the worst system of distribution in the world, since it is here that the great fortunes are piled up. *There can be no question that the better wage and the greater prosperity of the American workman is due primarily if not wholly to the fact that the American workman in every line of industry actually produces from two to five times as much per man-hour as does his European brother.* The reasons for this fact need not concern us here. They lie partly no doubt in our national resources, partly in a spirit of accomplishment which has been created here, and partly, though not wholly, in our use of labor-saving machinery. But it is the fact and the obvious consequence of it in the increased opportunity and well-being of the average man to which I would here call attention. *How unimaginable then the stupidity and how pathetic the blundering of that large class of labor leaders who are endeavoring to improve the conditions of labor by limiting production.* Such efforts can only bring disaster. If successful they merely result in robbing one class at the expense of another, and the robbed class is, in general, the one which is already least favorably situated.

However important, then, the problems of distribution may be there can be no uncertainty about the even greater importance of the problems of production. One little new advance like the discovery of ductile tungsten, which makes electric light one third as expensive as it was before, is a larger contribution to human well-being than all kinds of changes in the social order. The man who finds a way to so harvest his hay as to make a given plot of ground feed twice as many cattle as it did before has contributed immeasurably to human welfare. So has the biologist who shows mankind how to defeat the law of Malthus and to propagate rationally instead of in accordance with the law of the jungle. Or again the pure scientists who for ten years worked out the properties of discharges of negative electricity through highly exhausted bulbs and so made possible the use of pure electron discharges in multiplying enormously the possibilities of telephonic and telegraphic communication—the cornerstone of international good will—have made their lives count for humanity as very few political or social reformers have ever been able to do. These are the sort of opportunities which lie before the young man who is now choosing his life work in science, and incomparable opportunities they are.

Imagine a country which is made up of hills and valleys and in which the valleys often become flooded so as to drown out the valley-dwellers. A part of the people of this country set to work to level down the hills and fill in the valleys so that all the inhabitants may live in safety. These are the political and social reformers. And another part, without attempting to interfere with the topography, set themselves the task of raising the whole level of the land or lowering the level of the water so that the danger of floods is altogether gone. These are the creators of new wealth, the scientists and engineers. Both groups are needful to progress, but I suspect that the second group is less likely to make costly mistakes and more likely to accomplish useful results than is the first group. Neither group, however, should slacken its effort.

Fifth, there is a new opportunity in science for the man who wishes to invest his

wealth so that it will yield the largest possible returns to his country and his race. The United States has not in the past been the leading scientific nation, it can not even claim to have been on a par with two or three of the foremost scientific nations, at least if population is considered in assigning places. The number of outstanding scientists whom we have thus far developed in this country has not been at all proportionate to our population. This I take it is not because we do not produce as able men as any nation, but because our ablest men have not gone in large numbers into scientific activities. Why? Simply because the public appreciation of science has not been strong enough; because the rôle which science plays in the march of progress has not in the past been sufficiently generally realized among us; and because we have not developed centers of scientific research in which the atmosphere of research can be breathed by the young American who is about to choose his life work. If anything has been demonstrated by the history of the last century it is that that nation which is in the forefront in scientific developments is the nation which is going to lead in commerce and in industry and in every other phase of human activity. For who with eyes to see and ears to hear and a brain to consider can doubt for a moment that the keynote of modern civilization lies in the control of nature's forces by man, and who can doubt that that country which ferrets out nature's secrets most successfully will be the country which controls those forces most effectively? What then can be done to make this country utilize its tremendous natural advantages to the full and play the rôle which it ought to play in the progress of science and the world? I might answer in terms of the programs of the nations which have been stimulated by the war to the development of new programs of scientific research. Great Britain, Canada, Australia, Japan, have all recently made large governmental appropriations in aid of research in the physical sciences. Some of them are founding with these funds great research institutes, as Germany did before the war. Efforts of this kind are not to be decried. They will undoubtedly serve a useful purpose. But they are not in themselves adequate to our American situation. The mode of approach is not that which conforms best to the genius of our institutions or which the experience of the past indicates is likely to yield the largest returns. Furthermore, we are already in many places in this country over equipped with facilities and under equipped with men. Every purely research laboratory, whether under the control of the government or of an industry, is in the first instance a man-consuming rather than a man-producing institution. Our greatest need is not for more facilities, but for the selection and development of men of outstanding ability in science. Find a way to select and develop men and results will take care of themselves. This need for the development of men can be met only by the American universities. But it can not be met even by them unless we check in some way the tendency, met because of the growth in numbers in all our universities, for instruction to encroach upon and crush out research. The stimulus to research which comes from its association with advanced instruction is unquestionable and the broadening influence of a university is perhaps well-nigh essential to the best growth of the scientific mind. Hour for hour research in universities is probably much more effective than research in detached research laboratories, but the difficulty is that the number of hours available in most of our universities is still pitifully small.

The universities can not possibly fulfill their function of selecting and developing scientific men of outstanding ability *unless they create within themselves the atmosphere of scientific research.* The creation of research men may not be the prime function of all universities but it should certainly be the prime function of some of them. One of the most urgent needs then of America to-day is for the development in connection with five or six American universities of great research institutes in the natural sciences, such as do not exist at all to-day, institutes in which there will be as many able investigators devoting two thirds of their time and energy to research as are now found in the detached research institutions like those of the Carnegie Institution and the Rockefeller Institute for Medical Research, or the research laboratories of the Western Electric, General Electric and the Westinghouse companies. It is believed that such institutes in connection with American universities, where they will be freed from the limitations of industrial laboratories, divorced from the narrowing influences of detached research institutions, so placed that the research atmosphere which they create can be breathed by the most talented youths who pass through our American educational system, will exert a very marked influence upon the development of preeminent scientific men in America and upon making this country a center of the world's scientific life and progress. How can such institutions be created? Perhaps by government initiative. But if we may argue from the past the development is likely to come about in America in another way. We have developed in the United States a highly patriotic and highly intelligent public sentiment which stimulates men of wealth and power to devote themselves and their fortunes to great public enterprises. No country in the world has developed such groups of private individuals who hold their talents and their wealth as public trusts. Most of our great advances in the past have been through private initiative, and I suspect Mr. Elihu Root was as usual a wise counselor when he said recently in substance, "If we are going to conserve the finest elements in Anglo-Saxon civilization, we must conserve the method of free private initiative and not depend primarily upon government aid." The great opportunity in science then for the man who wishes to invest his funds where they will count most for his country and his race lies in the endowment of research chairs, or better semi-research chairs, in a few suitably chosen educational institutions. Such monuments ought to be infinitely more attractive than those of brick and stone. Such a chair endowed in such a way as to attract the ablest men whom we develop and filled continuously by fertile men will yield bigger returns to the donor and to the world than any other investment which can be made. Therein lies the greatest opportunity which America offers to the philanthropist to-day.

If some such program as I have outlined for producing scientific men and for creating centers of research in connection with a few American universities can be adopted in the United States, and I think it will be, then in a very few years we shall be in a new place as a scientific nation and shall see men coming from the ends of the earth to catch the inspiration of our leaders and to share in the results which have come from our developments in science. If we fail to seize these opportunities then the scepter will pass from us and go to those who are better qualified to wield it.

R. A. MILLIKAN

UNIVERSITY OF CHICAGO

CHEMISTRY IN THE NAVY[1]

In the spring of 1917, at meetings of the United States Nitrate Commission, the Navy came into closer touch with the chemists of the country that it had ever had the fortune to do before. This association resulted in much advantage to the navy upon the outbreak of war, the increased production of munitions being to large extent dependent upon the chemical help the Navy could obtain. The Navy, through the American Chemical Society, obtained practically all of its chemical assistance; and it learned to respect and appreciate the services given to the country by this large organization.

The smokeless powder of this country is a nitro-cellulose powder that was made possible by such great chemists as Monsieur Vieille, who, working with Nobel's gun-cotton, placed it in form for Mendeleeff to colloid, and, then, our American chemist, Francis du Pont, introduced the process of dehydrating. The development of this powder to its present form of great stability and ballistic regularity is due to many chemists who have given their entire time to this part of the explosives industry. The problems of the Naval service differ essentially from those of the general military service, in that, with explosives, certain limitations are set by the conditions in which they are stored and used on board ship. Many explosives, prepared for use on shore, are utterly unfit for use in the Navy.

The attempt to avoid excessive erosion was one of the many causes which led to the adoption, in this country, of a pure nitrocellulose powder as a propellent instead of nitro-glycerine compound used so generally.

There are many new requirements for propellent powders which the Navy hopes to meet with the help of chemists. One is the reduction of flash.

In the field of high explosives, the wet guncotton was discarded about 1908, for T.N.T., which is now the accepted high explosive for mines and torpedoes. During the war, it was necessary to obtain an additional high explosive, one in which toluol was not used, and, for this reason, the Navy adopted a high explosive called T.N.X., which is made by nitrating xylol, one of the lighter oils extracted in the production of toluene. This is not as convenient an explosive to use and handle as T.N.T., but met the situation satisfactorily. This was introduced through the Chemical Research Department of the du Pont Company. Amatol was not used by the Navy to any extent, as it did not stand Naval conditions. Our depth charges, loaded with T.N.T. instead of amatol, which our Allies had been forced to use, were said to be, and apparently were, much stronger than theirs. In fact, German prisoners complained of the exceptional violence of the American depth charges.

In the field of research in connection with automobile underwater torpedoes, there needs to be developed a new source of power. The present source is compressed air and the new source must be of greater potential per unit volume and weight and be nearly as safe to handle and store on board ship. Oxygen has been proposed but is too dangerous to handle.

In the metallurgical line, the Navy demanded a high quality of steel in all gun forgings, and, as a result, there are many more firms now capable of producing such steel than there were before the war, so that the designer is benefited greatly. Special investigations with alloys of steel have been continued and the properties of zirconium for armor plate are still being looked into.

During the war, a large number of pyrotechnic devices, such as smoke-producing apparatus, marker shells, signals, smoke shells, incendiary bombs, and illuminating star shells were worked with and considerable progress had been made along these lines, but it is especially desired to develop this field to much greater efficiency.

The Navy, in gas warfare, was confronted with the fact that whatever gas it developed could occupy a place in a shell so little as not to prevent penetration of the ship's side and

[1] Abstract of an address given at the Philadelphia meeting of the American Chemical Society by Ralph Earle, Rear Admiral, U. S. Navy, chief of Bureau of Ordnance.

subsequent detonation of the shell. Also, the Navy gas mask adopted was of a form such as would make the gun's crew load and handle the guns with the least possible interference, and so this form was considerably different from that adopted by the Armies of the world.

The Navy trusts that the post-war needs will find the chemists and officers of the service much closer together than they were in the pre-war days, and believes that such a condition will take place because we have had the pleasure of meeting so many of your organization and know better to whom to apply to obtain the necessary coöperation and advice.

BUREAU OF ORDNANCE,
NAVY DEPARTMENT

SCIENTIFIC EVENTS

THE WELSH UNIVERSITY AND THE WELSH NATIONAL MEDICAL SCHOOL

IN regard to the plans for the Welsh National Medical School we learn from *The British Medical Journal* that the university deprecates the proposal of the Royal Commission to make the medical school a separate constituent college of the university, thus severing the connection which has hitherto existed between Cardiff College and the school. It is considered that anything which will tend still further to separate the medical students from the general body of students, or to discourage intercourse between the professors in the medical and other faculties, is undesirable from the educational point of view, and it is stated that both the bodies concerned—the university college and the hospital—are opposed to the change. At the same time the university is fully alive to the importance of organizing the medical school as an institution of national and not merely of local concern. It is believed that both these objects can be attained through the revised scheme in which ultimate control is reserved to the university. It is proposed that the college council shall be the chief governing body of the school of medicine, but that it shall delegate to the board of medicine wide administrative and executive functions and powers. Specific proposals have now been put forward with regard to the remuneration of professors; it is pointed out that the fall in the value of money and the increased scale of salaries now being adopted in England make it clear that unless the University of Wales is to be in a position of permanent inferiority to the modern English universities it will be necessary to fix a scale substantially higher than the minimum figures proposed by the Royal Commission. It is suggested that the figures should be—for professorial chairs £800 to £1,000, for independent lectureships £500, for lectureships £400, and for assistant lectureships £250. Certain special proposals are made with regard to chairs and lectureships in the faculty of medicine. The adoption of the "unit" system is advocated. The medical unit would consist of two full-time teachers, a professor with a salary of £1,500, an assistant professor with £250, and part-time lectures on toxicology and forensic medicine, and on dermatology, £100 each. The surgical unit, it is suggested, should have three full-time teachers, a professor with a salary of £1,500, two assistant professors (one for practical surgery) £1,000; part-time lecturers on orthopedics, genito-urinary surgery, ophthalmology, and diseases of the ear, nose and throat, each to receive £100. The unit of gynecology and obstetrics would have one full-time professor (£1,500) and one full-time assistant professor (£500). There would be also an electrical department with a medical superintendent (£500), and clinics for psychiatry and neurology, pediatrics, dermatology, and dentistry, which it is estimated will together cost £5,000 a year. The salaries of the professors and assistant professors have been fixed on the assumption that having regard to their professorial duties the incumbents would be very largely restricted in private practise.

CONFERENCE ON THE ORGANIZATION OF RESEARCH IN ENGLAND

PART of the scheme devised by the Department of Scientific and Industrial Research for the administration of the funds placed at its disposal by Parliament was the formation of associations among groups of manufac-

turers, and a conference was held on July 29 of representatives of the associations already formed for the purpose of discussing some of the many problems which have presented themselves in connection with their work.

In the absence of Mr. H. A. L. Fisher, president of the Board of Education, the chair was taken by Sir William McCormick, chairman of the Advisory Council. Sir Frank Heath, secretary of the Department of Scientific and Industrial Research, was also present, besides some sixty to seventy representatives. A great diversity of subjects was thus represented, though some, especially the great chemical industries, were conspicuously unrepresented.

The meeting was informed that nine research associations were in operation, eight more have been approved and are only waiting the license of the board of trade, while twelve others are under discussion. So much having been accomplished in the three years which have elapsed since the idea originated, it may be assumed that a general approval has been given to the scheme by the industrial world, but the initial difficulties are far from being overcome as yet.

Among the subjects discussed at the conference the first was the formation of a records bureau, and the second the difficult and important one of the conditions of employment of research workers engaged by the associations. Other questions related to cooperation among the associations, and the amount and method of assessment of the subscriptions to be paid by the associated firms in addition to the subsidy from departmental funds.

The formation of a bureau of information and for the recording of results secured by research is a matter of the utmost importance. In the first place it is proposed that its task should consist in storing up the results of work done by the associations, but even this will be found very expensive and not free from difficulties, owing to the views prevalent in some quarters as to secrecy. The associations require access to information of every kind, and apparently the representatives assembled have something to learn with regard to the existing sources of much of the information they require, for throughout the discussion no reference was made to the magnificent journals, containing both original papers and abstracts, issued by some of the British and American engineering and chemical societies. It seems to be recognized that a large number of reference libraries will have to be established, especially in the neighborhood of great centers of industry; but it ought also to be understood that every association will require a library stored with works of reference, and especially journals cognisant of the subjects it represents; indeed, every works which has a laboratory for research must be similarly provided. All this represents a large outlay of money, the amount of which can scarcely be calculated as yet.

THE AMERICAN CERAMIC SOCIETY

The program for "Ceramic Day" at the Fifth National Exposition of Chemical Industries, Chicago, September 24, was as follows:

Morning Session

Professor Charles F. Binns: "The American Ceramic Society, past, present and future."

Dr. Alexander Silverman: "Buy on analysis."

Dr. E. W. Washburn: "Some aspects of scientific research in relation to the glass industry."

Mr. Ross C. Purdy: "Superior refractories."

Mr. Frederick H. Rhead: "The making of pottery."

Afternoon Session

Mr. Robert J. Montgomery: "General types of optical glass."

Mr. Douglas F. Stevens: "Brick and tile."

Mr. A. V. Bleininger: "The application of scientific methods to ceramic research."

Dr. J. C. Hostetter: "The manufacture of optical glass."

Mr. R. R. Danielson: "Enameling technology."

Mr. A. Malinovszky: "Fused silimanite products."

Evening Session

A full evening's program of motion pictures, including:

"Making of cut glass."

"Glass bulb and tubing manufacture for Mazda lamps."

"Manufacture of architectural terra cotta."

According to information supplied by Mr. Chas. F. Binns, the American Ceramic Society was founded in 1899, at Columbus, Ohio, when a small group of scientific men, interested in the problems of the silicate industries, gathered together and formed a permanent organization. Beginning with the report of that meeting a volume of *Transactions* has been published each year for nineteen years. In addition to the annual volume, a Manual of Ceramic Calculations, as an appendix to Volume 11, and the works of Hermann A. Seger, translated from the German, were published.

Clays and glazes were the earliest interests of the society but were soon followed by all branches of the silicate industries.

The growth in membership was steady but not large until 1917, when conservatism yielded before a vigorous campaign under the Membership Committee, resulting in an increase of over 200, a movement which has continued up to the present when there are 1,156 members.

In 1918 the annual volume of *Transactions* was superseded by the *Journal of the American Ceramic Society,* with G. H. Brown as editor. There has been a gratifying improvement in this *Journal* during the year and three quarters of its existence, and it now ranks with the scientific journals of much larger societies.

Local sections have been organized in places where there are many ceramists, who meet frequently for the discussion of papers and for good-fellowship. More recently Industrial Divisions have been formed for the better grouping of interests at the annual meetings. It is probable that hereafter there will be one or two general meetings and the rest of the time will be given over to divisional meetings.

SCIENTIFIC NOTES AND NEWS

DR. HENRY A. CHRISTIAN, Hersey professor of the theory and practise of physics in the Harvard Medical School and physician-in-chief to the Peter Bent Brigham Hospital, has been granted a leave of absence from his Boston work to serve for a year in Washington as chairman of the Division of Medical Science of the National Research Council and will begin that work on October 1.

DR. AUGUSTUS TROWBRIDGE, professor of physics at Princeton University, has received for his work in organizing and directing the sound-ranging and the flash-ranging in the American Expeditionary Forces the distinguished service medal. He has also been decorated with the British D.S.O., and has been made Chevalier of the French Legion d'honneur.

PROFESSOR GILBERT N. LEWIS, dean of the college of chemistry, University of California, formerly lieutenant colonel in the Gas Service, A. E. F., has been decorated as Chevalier of the French Legion d'honneur.

DR. MORTON PRINCE, of Boston, has been decorated with the Cross of the French Legion of Honor for his services in promoting Franco-American cooperation during the war.

LIEUTENANT COLONEL ELMER K. HILES, formerly of the Engineers, American Expeditionary Forces, has joined the Pittsburgh Testing Laboratory as manager of laboratories.

JACK J. HINMAN, JR., formerly captain in the Sanitary Corps of the American Expeditionary Forces, where he was engaged in water supply work, has returned to his pre-war duties as water bacteriologist and chemist to the Iowa State Board of Health and assistant professor of epidemiology in the State University of Iowa.

NORMAN A. SHEPARD, assistant professor in chemistry at Yale University, has resigned to enter the employ of the Firestone Tire & Rubber Company.

JULIUS B. KOHN, formerly employed by the U. S. Public Health Service as organic chemist doing research work under the direction of Dr. Julius Stieglitz on arsphenamine and neoarsphenamine at Kent Chemical Laboratory of the University of Chicago, is now connected with the Mallinckrodt Chemical Works as research chemist in their organic department, at St. Louis, Mo.

THE Massachusetts Department of Health celebrated the fiftieth anniversary of its estab-

lishment at the State House, on September 18. Among the chief speakers were Dr. Henry P. Walcott, Boston; Dr. William H. Welch, Baltimore; Assistant Surgeon Allan J. McLaughlin, U. S. P. H. S., and Sir Arthur Newsholme, of England. The health commissioner, Eugene R. Kelly, Boston, presided, and the visitors were welcomed on behalf of the state by the governor.

Dr. Frederick Eberson, of the Rockefeller Institute for Medical Research, has accepted a position at the Washington University to study, experimentally, the "Latent syphilitic as a carrier." The research is to be done in the department of Professor M. F. Engman.

Professor J. E. Petavel, F.R.S., has been appointed director of the British National Physical Laboratory in succession to Sir Richard Glazebrook, C.B., F.R.S., who retired on reaching the age-limit on September 18. Professor Petavel is professor of engineering and director of the Whitworth Laboratory in the University of Manchester.

A correspondent writes: M. Emmanuel de Margerie, the eminent French geologist and geographer and translator of Suess' "Antlitz der Erde" into "La Face de la Terre," has lately been appointed director of the Geological Survey of Alsace and Lorraine, in connection with the reorganization of the University of Strasbourg under French control, where Gofreaux is professor of geology, Baulig and Denis of geography, and J. de Lapparent of mineralogy. To the best of our knowledge this is the first official position that de Margerie has ever held; all his work heretofore has been done as a private individual. There is no other geologist in the world who has attained so high a rank in his science by individual effort, without support from government bureaus or university appointments. De Margerie's new address is Service de la Carte Géologique d'Alsace et de la Lorraine, 1 rue Blessig, Strasbourg, France.

Dr. Barton Warren Evermann, director of the museum of the California Academy of Sciences has gone into the Olympic Mountains west of Puget Sound for the purpose of studying the Roosevelt elk in its native habitat. An expert Pathé moving picture photographer has been taken along to get a film showing this species of big game in action in its wild state and under natural surroundings. The film will be used by the academy in its educational work to supplement the habitat group of these animals which, through the generosity of Mr. Wm. C. Van Antwerp, the academy is now installing in its museum in Golden Gate Park.

The committee on cooperation of the Ecological Society of America has just completed a field study of the plants and animals at timber line on Mt. Morey in the Adirondack Mountains of New York. Coincidently with the field study some of the research problems in ecology were discussed and listed. The committee included representatives of the three main lines of activity of the society, plant ecology, animal ecology and forestry. The persons and institutions cooperating are Barrington Moore, president of the Ecological Society, Norman Taylor for the Brooklyn Botanic Garden, George P. Burns for the Vermont Agricultural Experiment Station, Charles C. Adams and T. L. Hankinson for the New York State College of Forestry at Syracuse.

It is announced in *Nature* that the widow of Professor Milne has decided to return to her native country, Japan, and that in consequence the house at Shide, Newport, Isle of Wight, in which Professor Milne did such important work in seismology is to be sold shortly by public auction.

Edward Payson Bates, a well-known steam engineer of Syracuse, N. Y., died on August 4 at the age of seventy-five years.

Dr. A. G. Vernon Harcourt, F.R.S., lately Lee's reader in chemistry at Christ Church, Oxford, died on August 23, aged eighty-four years.

Professor Alexander Macalister, F.R.S., professor of anatomy in the University of Cambridge, died on September 2, aged seventy-five years.

Dr. C. A. Mercier, physician for mental diseases to Charing Cross Hospital, and a distinguished authority upon mental diseases and related subjects, died on September 2 at sixty-seven years of age.

The death is announced of Dr. William Smith Greenfield, professor of pathology and clinical medicine in the University of Edinburgh from 1881 to 1912.

The Bureau of Mines Experiment Station at Pittsburgh will be dedicated with suitable ceremonies on September 29 and 30 and October 1. The exercises carried out in connection with the Pittsburgh Chamber of Commerce include an excursion to the experimental mine near Bruceton, and first-aid and mine-rescue contests.

The seventh meeting of the Spanish Association for the Advancement of the Sciences was held at Bilbao from September 7 to 12. There will be eight sections. The French Association for the Advancement of Science and corresponding bodies in Great Britain, Italy and other nations, have been invited to send delegates.

The South African Association for the Advancement of Science held its annual meeting from July 7 to 12 inclusive, the first three days in Kingwilliamstown, the last three in East London. Wm. Flint, D.D., librarian of the Union of South Africa Parliament, was this year's president. Dr. I. B. Pole Evans, D.Sc., chief phytopathologist to the Union government was elected to succeed him. The outstanding feature of the meeting was a paper by Dr. A. Pyper, M.D., of Bethal, Transvaal, on "Diffraction phenomena in films of blood-cells and in surface-cultures of micro-organisms," in which these phenomena were applied for exact measurement of diameter of blood-cells, etc. The total attendance of members of the "S_2A_3" (as the association is called in colloquial speech in South Africa) was over 110.

Authority has been granted for the killing of 1,000 three-year-old seals on St. Paul Island this fall for food for the natives, and to increase the take of 4-year-olds on St. George Island from 300 to 500 in the current season. Killing of 6-year-olds and over will also proceed less vigorously on St. George Island, as proper proportions between the different age classes on that island are being more nearly attained. The above modifications in the quota have been made upon recent telegraphic recommendations of employees in charge at the Pribilof Islands.

Particulars respecting the British government competition for the construction of aeroplanes and seaplanes on the lines of increased safety are given in *Nature*. The following prizes are offered: For aeroplanes of small type: First prize, £10,000; second prize, £4,000, and third prize £2,000. For large aeroplanes: First prize, £20,000; second prize, £8,000, and third prize, £4,000. For seaplanes: First prize, £10,000; second prize. £4,000, and third prize, £2,000. The latest date for entries is December 31 next. Sir H. H. Shephard has instituted a memorial to his son, the late Brigadier-General G. S. Shephard, in the shape of prizes for members of the Royal Air Force for essays relating to aviation. This year the prizes are to be awarded for essays on "Sea and Fleet Reconnaissance" and "Aerial Navigation and Pilotage." The administration of the annual competitions is to be carried out by the Air Council.

Hydrobiologists and others interested in the study of bottom fauna may now obtain, made to order in the United States, a quantitative bottom-sampler as used by Peterson in recent investigations at the Danish Biological Station. These machines are being built by a competent and responsible house in Illinois, whose name and address may be obtained by writing the State Natural History Survey, Urbana, Illinois. One machine is already in successful operation at the Illinois Biological Station, and a second is being made for another Illinois institution.

UNIVERSITY AND EDUCATIONAL NEWS

The Lord Strathcona legacy to Yale University, which amounts to about $600,000 will

be used as follows: Two professorships in the graduate school will be established, and several fellowships founded, and a memorial building, costing about $250,000, will be built.

JULIUS ROSENWALD, of Chicago, has offered six scholarships of $1,200 each for negro graduates of American medical schools who desire to take post-graduate work in pathology, bacteriology, physiology, pharmacology or physiological chemistry. Appointments in 1920 will be made by a committee comprising: Dr. William H. Welch, Johns Hopkins School of Public Health, chairman; Dr. David L. Edsall, dean of the Harvard Medical School, and Dr. Victor C. Vaughan, dean of the medical department, University of Michigan. Abraham Flexner, secretary of the General Education Board, will be secretary of the committee.

THE trustees of Vassar College have announced an increase in salaries ranging from 50 per cent. in the lowest grade to 12½ per cent. for full professors. It applies to all teachers who have served the college a year or more.

THE salaries of professors and other members of the teaching force of the University of Mississippi have been uniformly raised on a scale of about fifty per cent.

THE department of anatomy at the Johns Hopkins Medical School has been organized as follows: Lewis H. Weed, professor of anatomy; Florence R. Sabin, professor of histology; George W. Corner, associate professor of anatomy; Charles C. Macklin, associate in anatomy; Robert S. Cunningham, associate in anatomy; Chester H. Heuser, associate in anatomy; Jean Firket, instructor in anatomy; William A. McIntosh, assistant in anatomy.

WILLIAM McDOUGALL, reader in mental philosophy in Oxford University, has been elected professor of psychology at Harvard University to fill the chair vacant by the death of Hugo Münsterberg.

DR. HERMAN MORRIS ADLER, formerly assistant professor of psychiatry in Harvard University, has been appointed professor of criminology and head of the department of social hygiene, medical jurisprudence and criminology in the medical college of the University of Illinois.

LIEUTENANT SAMPSON K. BARRETT, U. S. N. R. F., who served as electrical officer on the dreadnaught *Wyoming* with the Grand Fleet in the North Sea, has been discharged from active service to accept an appointment as assistant professor of electrical engineering at New York University.

PROFESSOR F. B. PADDOCK, state entomologist of Texas, has accepted the position as state apiarist of Iowa and as associate professor in the department of zoology and entomology in the Iowa State College, to fill the vacancy caused by the resignation of F. Eric Millen, who took charge of the apicultural work in the Ontario Agricultural College on July 1.

DR. T. G. YUNCKER, of the Michigan Agricultural College, has been appointed assistant professor of biology at DePauw University, Greencastle, Indiana. He will have charge of the botanical work.

DR. OTTO STUHLMAN, JR., associated with the department of physics at the State University of Iowa for the period of the war, has accepted an assistant professorship in physics at West Virginia University.

VICTOR E. NELSON, associate in chemistry, Johns Hopkins University, has accepted a position as assistant professor in charge of physiological chemistry at the Iowa State College.

DR. FRANCIS M. VAN TUYL, associate professor of geology and mineralogy in the Colorado School of Mines, has been appointed professor and head of the department of geology and mineralogy in that institution.

DISCUSSION AND CORRESPONDENCE

BIRTHS AND DEATHS IN THE CIVIL POPULATION OF FRANCE IN THE WAR-TIME

TO THE EDITOR OF SCIENCE: In the current number of SCIENCE (September 12) just received there are published the figures from

the "Journal Officiel" of the birth and deaths for 1913, 1914, 1915, 1916 and 1917 in the French departments not included in the zone of occupation and military occupations. These show a terrible increase of deaths over births. To give the whole picture of the serious effects of the war on the French civil population the figures are needed for the occupied territory. I can provide a few as a result of opportunities offered while at work in occupied France for the Commission for Relief in Belgium and North France.

In Lille, by far the largest city in occupied France, there was in the two years 1915 and 1916 a 47 per cent. decrease in births and a 45 per cent. increase in deaths as compared with pre-war ratios. This determination takes into account the difference in population of the city between the pre-war and the war years produced by an escape of one fourth of the city's inhabitants before the German forces occupied it, but it does not take into account the fact that this diminution of population was not effected by a simple random selection among the whole population (*i. e.*, by a proportionate lessening of all age groups and both sexes) but resulted largely from the removal for military service of almost all physically fit men of the age-group twenty to forty-five years. Part of the diminution also was caused by the emigration at the time of the invasion of entire families of the well-to-do class able to afford the expense of removal. This last group may perhaps be taken to be, on the whole, a particularly healthy group. In making, therefore, direct comparison of the mortality ratios for the two periods (war and pre-war) these special facts should be taken into account.

The increased percentage of deaths occurred especially in the age-groups 1 to 19 years, where it was 81 per cent. more in 1915–1916 than in 1913–1914, and 60 years and over, where it was 85 per cent. The principal immediate causes of the increased deaths were tuberculosis, brain hemorrhages and heart affections. The ultimate causes were of course certain war-produced conditions, especially the insufficient amount and variety of food and the necessity for a renewed return to hard work in the fields by old men and women to make up for the absence of the able-bodied men.

Data with regard to Charleville, another French city in the occupied territory, but one in an agricultural rather than an industrial region—Lille is the center of North France's principal industrial region—show almost identical conditions. And I believe from my personal observations during 1915 and 1916 over the whole of the occupied territory that the death-ratios in these two cities are a fair sample of those for the whole of the occupied region. The occupation extended, of course, for a much longer period than merely 1915 and 1916. It extended from late in 1914 until late in 1918. Undoubtedly these ratios of lessened birth-rate and increased death-rate in the occupied territory of France for 1915–1916 are not greater, but probably because of the increase of exhaustion and difficulties with food, fuel, clothing, medical service and supplies, less than those for 1917 and 1918.

VERNON KELLOGG
NATIONAL RESEARCH COUNCIL,
WASHINGTON

INSTINCTIVE BEHAVIOR IN THE WHITE RAT

IN confirmation of Mr. Griffith's observation of a possible case of instinctive behavior in the white rat reported in SCIENCE for August 15, 1919, I wish to add a somewhat similar observation which I made a few months ago.

Upon placing a few handfuls of fresh dandelions into a cage of some twenty white rats of various ages which had been reared in the laboratory for several generations, much to my surprise I found the rats at once ran away from the greens and gathered in one corner of the cage and behaved in a thoroughly frightened manner. At first I could not account for this strange behavior, for hitherto the rats had fed with avidity on fresh dandelions and seized the plants as soon as they were placed in reach. On further thought, I recalled that I had gathered the dandelions on this occasion in an old basket which had recently been used for bringing a

live cat into the laboratory and which had probably imparted an odor of cat to the greens.

I did not watch the rats very persistently, but the next day I noted that their behavior was perfectly normal and that the greens had been entirely eaten. It may be said with certainty that these animals which were so terrified had never in their experience been near a cat.

At the same time that I was working with white rats I had to use some rabbits and had occasion to handle some rats immediately after handling the rabbits. The rats did not respond in any peculiar way in the presence of the odor of rabbits, and as this was just as strange an odor as that of cat, it can hardly be assumed that this reaction of fear in the presence of the odor of cat was due simply to the novelty of the stimulus.

B. W. KUNKEL
LAFAYETTE COLLEGE

AN EARLIER SNOW EFFECT

TO THE EDITOR OF SCIENCE: In your issue of August 29, Professor Woodman, University of Maine, describes an unusual snow phenomenon, and he states that it would be interesting to know if others have observed anything like it in other localities. It may therefore be worth while to call attention to a similar phenomenon described by Thoreau in his "Journal," Vol. XIII., pages 24–26:

> I see, in the Pleasant Meadow field near the pond, some little masses of snow, such as I noticed yesterday in the open land by the railroad causeway at the Cut. I could not account for them then, for I did not go to them, but thought they might be the remainders of drifts which had been blown away, leaving little perpendicular masses six inches or a foot higher than the surrounding snow in the midst of the fields. Now I detect the cause. These (which I see to-day) are the remains of snowballs which the wind of yesterday rolled up in the moist snow. The morning was mild, and the snow accordingly soft and moist yet light, but in the middle of the day a strong northwest wind arose, and before night it became quite hard to bear.
>
> These masses which I examined in the Pleasant Meadow field were generally six or eight inches high—though they must have wasted and settled considerably—and a little longer than high, presenting a more or less fluted appearance externally. They were hollow cylinders about two inches in diameter within, like muffs. Here were a dozen within two rods square, and I saw them in three or four localities miles apart, in almost any place exposed to the sweep of the northwest wind. There was plainly to be seen the furrow in the snow produced when they were rolled up, in the form of a very narrow pyramid, commencing perhaps two inches wide, and in the course of ten feet (sometimes of four or five only) becoming six or eight inches wide, when the mass was too heavy to be moved further. The snow had thus been rolled up even, like a carpet. This occurred on perfectly level ground and also where the ground rose gently to the southeast. The ground was not laid bare. That wind must have rolled up masses thus till they were a foot in diameter. It is certain, then, that a sudden strong wind when the snow is moist but light (it had fallen the afternoon previous) will catch and roll it up as a boy rolls up his ball. These white balls are seen far off over the hills.

This description is accompanied by a drawing, so characteristic of Thoreau, showing the cylindrical ball and its path in the snow.

BENJAMIN FRANKLIN YANNEY
THE COLLEGE OF WOOSTER,
WOOSTER, O.

QUOTATIONS

THE ARMY AND SCIENCE

THE university has not yet been accustomed to think of the army as an institution in which scholarship flourishes. Nor has the army been interested in the work of the university. Each went its way in the belief that its task was so different from the other that the benefit to be derived from cooperation would be outweighed by the trouble involved. That this attitude has been completely changed is due more to the changes in fighting than to those in teaching. It was only a short while ago that such an expression as "the science of war" flattered the activity of generals and their armies. The infantry had to know how to shoot and the cavalry how to ride. Tactical problems, solved by the General Staff, consisted largely in the accurate reading of maps and the direction of marches

and location of points suitable for attack or necessary to be taken.

The war, the end of which the unpolitical majority of us are now longing to greet, was, however, grimly scientific in its every aspect. Aviation commandeered the mechanical engineer, the astronomer and the photographer. The submarine demanded that the physicist tell us all he knew. Without the chemist gas could not be used. Camouflage confused and confounded enemy mathematics: there were no lines straight in the right way, nor rectangles by which to calculate ranges and set guns. The wireless in its manifold applications made the skilled electrician work. Men were selected—they had to be—according to tests determined by the psychologist. And so on, until the colleges used "direct action" and took the young soldier under their immediate supervision, an act in itself necessitating a coordination between the army and the university that was undreamed of twenty years ago.

In an illuminating article in the *Columbia University Quarterly* Mr. Frederick Paul Keppel, until recently Third Assistant Secretary of War, has detailed some of the achievements of academic men (to use an adjective which the War Department affects to loathe) that helped us to win the war. The archeologist designed the best trench helmet; the tropical botanist told us how to get charcoal for gas masks; the astronomer showed us that it is the shape of a moving thing's tail and not its head that determines its course; the lawyer directed war finance; the physicist and chemist brought our production of field glasses up from 1,800 in 1914 to 3,500 in a single week in 1918; the physician greatly decreased our death rate by chemical sterilization and the splinting of fractures; the anthropologist showed that it is the breadth of a soldier's hips and not the length of his legs that gives him marching ability; a doctor of philosophy established conferences for the discussion of technical problems, and thereby prevented excellent suggestions from dying a quiet death in the pigeonholes of the War College.

SCIENTIFIC BOOKS

Menders of the Maimed: The Anatomical and Physiological Principles underlying the Treatment of Injuries to Muscles, Nerves, Bones and Joints. By Arthur Keith. London, Oxford Medical Publications (Henry Frowde; Hodder and Stoughton). 1919. Pp. 335.

Those who had the good fortune to hear Professor Keith during his tour of the United States in 1915 will need no further introduction or incentive to read this book than the statement that the author has written it as he speaks—in the same delightful conversational style which characterizes his public lectures in the college of surgeons.

The subtitle, far too cumbersome for a book heading, gives the substance of its contents which are the written records of the lecture course for 1917–18. "Menders of the Maimed" rightly interprets the book, the inspiration of which is a renewed interest in treatment of the locomotor and nervous systems elicited by the war.

"Men of business find it necessary from time to time to take an inventory of the goods they have in stock; occasions arise when medical men must do the same thing and make a survey of the means of treatment at their disposal. That is the case now; surgeons are being called on to restore movement to thousands of men who have been lamed or maimed in war; they find it necessary to reexamine the foundations of their science and practise. In this book I have sought to help them by a restatement of the principles which underlie the art of orthopædic surgery." Thus the author expresses his mission and he carries it out in a way at once characteristic of himself and appealing to the reader for he builds the history of orthopædic surgery around those who themselves made the history. As we read we actually feel the presence of John Hunter's restless active figure. We see Hilton, sarcastic and independent, his waistcoat with its decisive pattern linked from pocket to pocket with a heavy gold chain. H. O. Thomas is in his workshop fashioning splints. Little seeks

help for his deformed foot and Lang for his injured knee. Duchenne walks the streets of Boulogne, his Faradic battery under his arm, and declaims against his critics. Lucas-Championnière, the ankylophobe protests eloquently against splints. Sayre captures his little patient in the New York slums still incased in his plaster jacket and triumphantly carries him off to his lecture theater.

"To assist myself," said Watts, the painter, "I converse with the sitter, note his train of thought, his disposition, his character and so forth, and having made myself master of these details, I set myself to place them on the canvas, and so reproduce not only his face, but his character and nature." So in this volume the author has absorbed something of the spirit of each pioneer and interprets that.

The general plan of the book is not a simple one with successive chapters following in orderly sequence for, as in a play, characters come and go and, whereas some cross the stage but once, others return again and again.

For instance the first chapters are biographical studies of Hunter, Hilton and Thomas.

Then follows the history not of a man but of a movement—that movement which led surgeons to practise tenotomy. The natural sequence to this, namely, the consideration of tendon transplantation and kinoplastic surgery is postponed until the story of the nerves and the control of muscles has been unravelled by Marshall Hall and those who followed him. The reason for this postponement is not far to seek. Scientific discovery and the application of principles are in history a disconnected sequence. Tendon transplantation has to be postponed in the book because the book is the interpretation of history and not a mere recital of events.

Later in the book when movement as a method of treatment finds its champion in Lucas-Championnière it turns out that the first three studies which appeared biographical are really historical phases of the contrasting doctrine of rest. Thus, being led to look at the subject from different viewpoints, we find the book full of surprises which arouse and renew our interest.

Only toward the end when dealing with bone and cartilage do we find a certain order, prescribed indeed by history but none the less stimulating because unexpected.

Valuable also is the last chapter on the history of bone-setting with a well-judged warning against the type of practitioner who, unsound in his fundamental knowledge, plays into the hands of charlatans.

In the rush of modern scientific life we are apt to ignore those who laid the foundations of our knowledge and even a discovery is often, as history shows, a rediscovery. "Our opinions," said Montaigne, "are grafted one upon another. Whence it followeth that the highest mounted hath often more honor than merit. For he is got-up but one inch above the shoulders of the last save one."

No student, seeking to know the history of investigation in the structure and function of the locomotor and nervous systems can afford to neglect this book and the story of "the last save one."

T. Wingate Todd

Western Reserve Medical School,
Cleveland, Ohio

THE PROGRESS OF UNDERGRADUATE RESEARCH IN MEDICAL SCHOOLS

Modern medicine is a scientific subject, and, in order to understand it completely, students must understand the methods by which the facts and theories of medicine have been acquired. The best way to learn the scientific method is by undertaking some research problem and so learning it first-hand. This is required for the degree of Ph.D. in a scientific subject, but students of medicine in some schools find it difficult or impossible to obtain the opportunity to do any research at all.

The faculty of the University of Pennsylvania are almost without exception believers in the educational value of undergraduate research, but the question of how properly to combine the time required for research and the exactions of the regular course remains an open one. Therefore, during the past session (1918–19) the William Pepper Medical

Society, an undergraduate society at the University of Pennsylvania, conducted a canvass of representative medical schools of the United States on the subject of undergraduate research. The attempt was made to determine the condition of undergraduate research, how the time for it was obtained, and what means (if any) were taken to encourage students to do this type of work. A somewhat similar canvass, conducted by Dr. C. K. Drinker in 1912,[1] permitted a comparison of the opportunities for undergraduate research in 1912 and at present.

The following letter was therefore sent to twenty-five medical schools:

DEAN OF THE MEDICAL DEPARTMENT.

Dear Sir: The William Pepper Medical Society (undergraduate) of the University of Pennsylvania desires to investigate the conditions under which undergraduate research work is being carried on in the principal medical schools of America.

The society believes that a knowledge of the methods of scientific research is of great value, and that greater opportunity to acquire this knowledge should be afforded to students who are interested.

We would request the favor of a reply upon the following questions, and hope that you will add any suggestions or comments that you would care to make. The committee would thank you for your trouble in the matter.

Very truly yours,
(signed) JOSEPH STOKES, JR.,
LYLE B. WEST,
ISAAC STARR, JR.,
Chairman,
Committee on Undergraduate Research

1. Do you allow undergraduates to undertake research in conjunction with their regular work?

2. Are any means taken by your faculty to encourage undergraduate research? If so, what means?

3. Approximately how many (and what per cent.) of your graduating classes have undertaken some research problem, under instruction of the faculty, during their regular course of study?

4. Does your curriculum permit a student to substitute time spent on research, under direction of a member of the faculty, for hours in the regular course, required or elective?

5. Do you believe that undergraduate research is justified by its educational value to the student?

The following tabulations were compiled from the replies of the deans of the institutions quoted except in the case of Johns Hopkins. As the dean of Johns Hopkins failed to respond, the attitude of that institution was ascertained from the catalogue and from conversations with undergraduates and therefore can not be regarded as entirely an official statement of that school.

By the answers to the first question we find that an overwhelming proportion of medical schools permit undergraduates to undertake research in conjunction with their regular work. Twenty schools allow this, two are doubtful (one of which gives only the first two years of the course) and only two forbid it. In 1912 seventeen schools permitted this, while eight opposed it. The opposition has shrunk from 32 per cent. to 9 per cent. in the last seven years.

Those permitting undergraduate research: California, Cornell, Colorado, Harvard, Illinois, Johns Hopkins, Leland Stanford, McGill, Michigan, Minnesota, Mississippi, Oregon, Rush, Texas, Tulane, Virginia, Washington (St Louis), Western Reserve, Wisconsin, Yale. *Those opposed:* Maryland, Geo. Washington (D.C.). *Doubtful:* Physicians and Surgeons (Columbia), North Carolina.

The following comment on question No. 1 was received:

Harvard—"Research is especially urged in certain departments." But, "There is a certain amount of opposition since men doing research at times neglect their other studies." (Letter of Assistant Dean Hale.)

In our experience the men who are interested in research have always stood well in their class. That this is also the experience of many medical schools is evidenced by their regarding the researcher as a "marked man." Any tendency to neglect other subjects for research could be easily controlled by requiring the student to maintain a general average somewhat above the passing mark while undertaking his research problem.

[1] SCIENCE, N. S., Vol. XXXVI., No. 935, pp. 729–738, November 29, 1912.

Reasons for a doubtful or negative attitude are given as follows:

P. and S. (*Columbia*)—"We do not advise it. Only a few can find time to do so." (Letter of Dean Lambert.)

Maryland—"We feel that the course is too comprehensive to allow the average student to spend time at anything other than his regular work."

The cause of the objections is the lack of time in the course. But the subject of medicine is a life study and can not be covered in four years. The value of a medical course must be measured not alone by the number of facts that the student masters during his four years at the medical school, but by the extent of his knowledge at the prime of his intellectual life. Therefore it seems strange that any school should not give its students some time in which they could work on their own resources, and, by learning to acquire knowledge without instruction, could become life-long students of medicine.

A study of the answers to question no. 2 reveals several methods by which undergraduate research is encouraged by the faculty. Several schols employ more than one method, which makes it difficult to classify them. The schools have been placed under the method on which they lay the most stress. These methods are as follows:

1. By personal advice and interest of members of the faculty—California, Colorado, Illinois, Harvard, Michigan, Washington, Virginia.

2. By allowing undergraduates to assist members of the teaching staff—Texas, Michigan, Tulane.

3. By requiring a thesis for graduation—Leland Stanford, Wisconsin, Yale.

4. By giving credit towards their degree—Rush.

5. By offering elective courses in research—Minnesota, Johns Hopkins.

6. Miscellaneous—

Cornell—"We encourage them by placing at their disposal every available facility for the study of approved problems." (From a letter of Dr. J. S. Ferguson, secretary of the faculty.)

Oregon—"All members of the class are at times assigned subjects to look up in the literature, bibliographies are at times required and these always suggest problems." (Letter of Dr. H. B. Myers, assistant dean.)

California—"Next year we are permitting two undergraduates to substitute for work in medicine, work in research which will be financed by scholarships from the university." (Letter of Dean H. C. Moffit.)

Schools which do not encourage it—George Washington (Washington, D.C.), Maryland, McGill, Mississippi, Physicians and Surgeons (Columbia).

From the answers to question no. 3 we find:

Over 50 per cent. of the graduating class has undertaken some research problem at Cornell and Yale.

Between 25 per cent. and 50 per cent. at California, Colorado, Washington.

Between 10 per cent. and 25 per cent. at Harvard, Leland Stanford, Minnesota, Rush.

Between 5 per cent. and 10 per cent. at Illinois and Michigan.

"Some little" at Mississippi, Texas, Virginia and Western Reserve.

None at George Washington (D.C.), Maryland, Physicians and Surgeons (Columbia).

Tulane replies that none of the present class has done any research because of the war.

We have no exact figures from Johns Hopkins, but the proportion is known to be high.

The fourth question is the most important one of the series because it determines whether research is made possible for the undergraduate. In order to work the undergraduates must have available time, sufficient in duration to allow for the completion of experiments. This time is provided in two ways: (1) by permitting a student to substitute time spent in research for hours in the regular course, or (2) by reducing the hours of instruction to such a point that enough free time is available.

The schools allowing students to substitute time spent on research are—California, Cornell, Harvard, Johns Hopkins, Minnesota, Oregon, Rush, Tulane, Washington (St. Louis), Wisconsin.

In 1912 only one school, Tulane, allowed such substitution.

Schools which have enough free time available are—Leland Stanford, Yale.

Schools permitting research but giving no time are—Colorado, Illinois, Michigan, Mississippi, Physicians and Surgeons (Columbia), Texas, Virginia.

In considering question five we find that a large majority is of the opinion that undergraduate research is justified by its educational value. The following medical schools answer affirmatively—California, Colorado, Cornell, Harvard, Illinois, Johns Hopkins, Leland Stanford, McGill, Michigan, Minnesota, Oregon, Rush, Virginia, Washington (St. Louis), Western Reserve, Wisconsin, Yale.

The schools which do not believe that undergraduate research is justified by its educational value—George Washington (Washington, D.C.), Maryland, Physicians and Surgeons (Columbia). The cause of the objection is the lack of time.

Mississippi, which gives only two years, is doubtful.

Reasons for favoring the proposition are given as follows:

Illinois—"Anything which stimulates a student to do independent thinking is justified." (Letter of Dean A. C. Eycleshymer.)

Michigan—"I know that those who have done some research are better students than those who have not." (Letter of Dr. V. C. Vaughan.)

Rush—"Because it is by all odds the most efficient pedagogic method." (Letter of Dr. J. M. Dodson.)

Virginia—"Where a man has the investigator's mind and is a sufficiently apt student to acquire his knowledge of the required subjects readily, such a man should be encouraged to do all the research possible and nothing in my judgment could be of greater educational value to this man." (Letter of Dean Theodore Hough.)

Washington—"We believe emphatically that undergraduate research is justified by its educational value to the student. In fact it is our belief, held generally in this school, that a piece of research may be of great value to a man in preparing him for the future. It is our opinion that the essential and most important object in medical education is to turn out men who will be life-long (N. B.) students of medicine, and there is nothing more valuable in cultivating this spirit than the pursuit of first-hand knowledge along some line of interest." (Letter of Dr. G. Canby Robinson, dean.)

In view of these facts we conclude:

1. The vast majority of Class A medical schools approves of undergraduate research in theory.

2. Many medical schools approve of it in practise by conceding hours from their regular course which may be devoted to research.

3. The opportunity for undergraduate research has increased greatly since 1912.

ISAAC STARR, JR.,
JOSEPH STOKES, JR.,
LYLE B. WEST
UNIVERSITY OF PENNSYLVANIA

SPECIAL ARTICLES

COMPLETE REVERSAL OF SEX IN HEMP

THE writer has been investigating the sexual condition of hemp (*Cannabis sativa* L.) for a number of years and has obtained results so remarkable that he thought it advisable to present this preliminary note on certain phases of the problem before the completion of all the experiments and observations now in progress.

Common hemp was planted in the winter, when light conditions were very low, on shallow greenhouse benches heated mainly from beneath. Aside from these three special conditions, the environment was practically normal. Under the stated conditions, the hemp matures very early, sometimes having not more than two pairs of leaves before the terminal flower cluster appears and never being more than a few inches high.

The plants are staminate and carpellate and are decidedly dimorphic. The main sexual differences are as follows: Carpellate plant—broad flat crown of leaves, vigorous appearance but not so tall as the staminate plant, large root system, large leaf blades, carpellate flowers with the perianth a closed sheath and with no vestigial stamens, and a long period of life and growth. Staminate plant—slender habit and taller than the carpellate plant, delicate appearance, small root system, small

leaf blades, staminate flowers with 3–6 separate sepals and no vestige of the gynecium, and a very short life as compared with the carpellate plant.

Some staminate plants produce only pure staminate flowers, the expression being purely male, others at first produce besides staminate flowers some abnormal, intermediate flowers with structures differentiated as part ovulary and part stamen, or with normal stamens and a vestigial ovulary which usually has normal stigmas. Frequently ordinary stamens are produced ending in normal stigmas and occasionally a pure carpellate flower with the typical sheath-like perianth is developed. The staminate, intermediate plants exhibit various degrees of female expression but apparently in all cases have a strong tendency to become more and more staminate as the blooming period advances, so that at the end only normal staminate flowers are produced. The progression of the sexual state is from femaleness to maleness.

The carpellate plants usually produce nothing but carpellate flowers at first. Occasionally, however, there is a plant which will immediately begin to grow taller than the average carpellate plant and develop stamens in some of the flowers. These plants appear somewhat intermediate not only in floral development but also in vegetative characters. The vast majority, however, of the carpellate plants develop no such characteristics but begin to produce normal carpellate flowers and seeds and continue with the typical carpellate appearance. After the carpellate plants are well advanced in age, many of them begin to show a change in sex and develop stamens or staminate flowers. Some begin the reversal at a comparatively early period, others not until the very last flowers are produced. Some individuals produce only imperfect stamens, apparently with defective pollen and with indehiscent anthers; others produce normal staminate flowers with dehiscent anthers and apparently normal pollen. In these normal staminate flowers, the perianth consists of typical, separate sepals exactly similar to those in normal staminate flowers produced on staminate plants. The reversal from femaleness to maleness is, therefore, of every degree of intensity or completeness both in the number of flowers produced and in the degree of perfection of the sexual structures themselves.

A number of individuals appeared normally carpellate and produced 2 or 3 normal seeds at first and then gradually changed to the staminate condition until finally before they began to die of old age purely male sex was being expressed. Nothing but typical staminate flowers with dehiscent anthers was being produced. Femaleness had been changed to maleness. In one plot over 50 per cent. of the carpellate plants were finally reversed in their sexual state to a greater or less degree.

It is evident, therefore, that in these experiments we have a complete reversal of sex from female to male in a species characterized by an extreme dimorphism and this without any manipulation of the plants whatever except that they were grown out of season with a deficiency of light, and a shallow soil heated partly from below.

Female heredity is at first active and male heredity is latent, and finally male heredity is active and female heredity is latent. The change takes place in the vegetative body and is plainly caused gradually by an internal change of the physiological state or condition of the meristematic tissues from which the flowers are produced.

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EPIDEMIOLOGY AND RECENT EPIDEMICS[1]

It has been the custom, I am informed, at these meetings to spend little time and few words on mere felicitations, but to proceed as promptly as may be to the business of the congress. However, you will, I know, indulge me long enough to enable me to express to you in some degree the sense of honor and responsibility which I feel on this occasion.

Since the last congress, which was held in 1916, in the midst of the racking uncertainties of the great war, notable events and serious calamities have befallen the world and arrested the attention of all thoughtful men. A bitter and passionate military contest has been brought to a hopeful conclusion; but because of the unparalleled cost of the struggle, in lives and in treasure, deep unrest, revolution even, starvation and diseases are prevailing over a large part of Europe, while also within the three-year period elapsed between the last congress and the present one three destructive epidemics of disease have ravaged the United States and the world.

Hence it has seemed fitting to me that on this occasion and before this representative body of medical men we should pause for a brief period in order to review, as it were, our knowledge of epidemics and at the same time of the practical hygienic measures, based on this knowledge, which we already put or in ordinary course of events may reasonably hope to put into motion against the spread of these epidemics, so that we may form a judgment of the efficacy of such measures and arrive possibly at new points of view from which to launch a more decisive attack. Moreover, it

[1] President's address, X. Congress of American Physicians and Surgeons, held at Atlantic City, N. J., June 16 and 17, 1918. This address appears in the *Journal of the American Medical Association.*

seems imperative that we should consider not only the sum of our knowledge of epidemics, but also certain facts relating to the population affected, which react powerfully on the successful application of the hygienic means available.

Three epidemic diseases, poliomyelitis, streptococcus pneumonia and influenza, have been especially destructive in the western world during the past three years; also, because of certain common characteristics, they are well adapted for the purpose I have in view.

In the United States we are becoming increasingly familiar with epidemics of poliomyelitis. Prior to 1907 infantile paralysis was a rare disease in this country; since then it has prevailed fitfully every summer and autumn, and in one notable instance, at least, in the winter season,[2] claiming victims by the score or hundred, until in 1916 an outbreak of unprecedented severity, with its center of violence in New York state, swept over a considerable number of states.

Fundamental knowledge of poliomyelitis may be said to have grown rapidly since Wickman's epochal clinical studies published in 1907. We are indeed to-day in possession of precise information covering essential data with regard to the nature of the inciting microorganism, notwithstanding its very minute size, and also concerning the manner in which it leaves the infected or contaminated body within the secretions of the nasopharynx chiefly and gains access to another human being by means of the corresponding mucous membranes and apparently no other way. Moreover, the inciting virus so called, up to the present time and notwithstanding many and assiduous efforts, has not been detected apart from the infected or merely contaminated human being, and there is therefore no foundation in ascertained fact for an assumption that the virus is conveyed to persons otherwise than by other persons who harbor it.

The second example, namely, that of streptococcus pneumonia, presents a phenomenon almost, if not quite, new among the epidemic diseases. It appears as if during the winter of 1917–1918 there occurred in several localities within the United States and also, but in less degree, in France, at least a great increase in the incidence of a type of pneumonia which previously had been very infrequent. It appears also that the greatest number of cases and of fatalities arose in the United States in the military cantonments; that the disease first prevailed as a secondary pneumonia following measles; but that before long the severity of the infection was such that cases of primary streptococcus pneumonia began to arise. Moreover, at this juncture the disease spread from the military to the civil populations.

The nature of the microorganism inducing this form of epidemic pneumonia is indicated in the name which the disease has come to bear. The difficulty in this instance has not been in finding out the inciting microbe, but rather in differentiating the streptococci responsible for the epidemic disease from streptococci possessing the ordinary pathogenic properties, or even from those of saprophytic nature so commonly present on the upper respiratory mucous membranes without provoking widespread disease. However, numerous studies of the bacteriology of this epidemic of pneumonia, at distinct and often widely remote cantonments, showed that the microbic incitant was in almost every instance *Streptococcus hemolyticus*. Moreover, because of the wide occurrence of the epidemic pneumonia, this type of streptococcus could be found in normal throats and as a secondary invading microorganism in the lungs in cases of ordinary lobar pneumonia. Thus far very little progress has been made in the classification of streptococci, which form a class apparently even more heterogeneous than the pneumococci.

The point I wish to emphasize is this: Regarding epidemic diseases in general we are wont to assume the introduction from without and usually from a distant locality of a special kind or race of microorganism which is held directly responsible for the epidemic ensuing. In the instance of the epidemic pneumonia no such importation or new introduction of the inciting streptococcus needs to be or actually is assumed. It is so

[2] Fairmont, West Virginia.

probable as to amount to practical certainty that the excessively virulent *Streptococcus hemolyticus* was developed by a process of selection, through successive transfer from person to person, and by gradual enhancement of its invasive properties.

We are in this case on safe grounds when we assert that the inciting streptococcus is always personally borne: that is, that it leaves the respiratory organs of one person to be introduced upon the corresponding organs of other persons, and in no other manner. In other words, the mechanism or mode of infection in epidemic streptococcus pneumonia, as in poliomyelitis, may be said to be clearly apprehended.

The case of influenza, the third and perhaps the most important example cited, is quite different, since wide divergences of belief and opinion regarding the nature of the inciting microorganism and the manner of infection still prevail. The reasons for these differences are several, but the most important perhaps relate to the common observation of the manner of spread or attack of the disease. To the casual observer there is something uncanny in the way influenza strikes down its victims. While other epidemics proceed from bad to worse, with at least progressive increases in intensity, influenza seems to overwhelm communities over even wide stretches of territory as by a single stupendous blow. While in the one case the gradually accelerating rate of speed of extension may be taken to indicate personal conveyance of the provoking microorganism, in the other case the sudden wide onset appears to be the very negation of personal communication.

Hence the invoking of mysterious influences, the revival of the notion of miasm and similar agencies, to account for this phenomenon. Indeed, the public mind in general lends itself readily to such formless concepts, for the reason that there still resides in the mass of the people, even in the more enlightened countries, a large uneradicated residue of superstition regarding disease. One does not need to look far or dig deep in order to uncover the source of this superstition. We have only recently emerged from a past in which knowledge of the origin of disease was scant, and such views as were commonly held and exploited were mostly fallacious. It is indeed very recently, if the transformation can be said to be perfect even now, that the medical profession as a whole has been completely emancipated. All this is very far from being a matter of remote importance only, since in the end the successful imposition of sanitary regulations involves wide cooperation, and until the majority of individuals composing a community is brought to a fair level of understanding of and belief in the measures proposed serious and sustained endeavor to enforce them is scarcely to be expected.

And yet no better instance of a communicable disease could perhaps be invoked than influenza to exorcise the false idea of the mysterious origin of epidemics. To dwell solely on the sudden and overwhelming stroke of the disease is wholly to overlook the significant incidents that precede the mass infection, because they are of such ordinary nature and lack all dramatic quality. Accurate observers noted long ago that influenza in its epidemic form did not constitute an exception to the common rule governing epidemic diseases which were obviously associated with persons and their migrations. What the early students made out by tracing the epidemic backward to its point of departure more modern observers have confirmed by carefully kept records, often graphically compiled, as in the excellent instance of the Munich records covering the epidemic of 1889–92, which can now be supplemented by a number of similarly constructed records of the epidemic just passed. These detailed records show convincingly a period of invasion during which there is a gradual rise in the number of cases, to culminate, within a period variously estimated at from one to three weeks, in a widespread so called "explosive" outbreak of the disease.

It happens that the early cases of epidemic influenza tend not to be severe, chiefly because they rarely are attended by pneumonia and hence are frequently mistaken; and the confusion in diagnosis is resolved only when the

full intensity of the epidemic is realized. In the meantime rich opportunity has been afforded for the free and unrestricted commingling of the sick and the well, of doubtless healthy carriers of the inciting agent and others, until so high a degree of dissemination of the provoking microorganism has been secured as to expose the entire susceptible element of the population, which happens to be large, to an almost simultaneous response to the effects of the infecting microbe.

Deductions of like import can be drawn from the geographical movements of influenza epidemics. In eastern Russia and Turkestan influenza spreads with the pace of a caravan, in Europe and America with the speed of an express train, and in the world at large with the rapidity of an ocean liner; and if one project forwards the outcome of the means of intercommunication of the near future we may predict that the next pandemic, should one arise, will extend with the swiftness of the airship. Moreover, not only is this rate of spread determined by the nature of the transportation facilities of the region or the era, but towns and villages, mainland and island, are invaded early or late or preserved entirely from attack according as they lie within or without the avenues of approach or are protected by inaccessibility, as in instances of remote mountain settlements and of islands distant from the ocean lanes or frozen in during winter periods.

It is desirable, in the interest of clear thinking, to carry this consideration of the characteristics of epidemic influenza a step further. A feature of the epidemic disease of particular significance is the tendency to recur, that is, to return to a stricken region after an interval, usually of months, of relative quiescence. Thus the beginnings of the last pandemic in western Europe and the United States have been traced to sporadic cases appearing in April, May and June, possibly earlier even in certain places, while the destructive epidemic raged during September, October and November of 1918. There are very good reasons for believing that in itself influenza is not a serious disease, but that its sinister character is given by the remarkable frequency with which it is followed, under particular circumstances, by a concomitant or secondary pneumonic infection to which the severe effects and high mortality are traceable. Now it is this high incidence of pneumonia, the product of invasion of the respiratory organs with bacteria commonly present on the upper respiratory mucous membranes—streptococci, pneumococci, staphyloccocci, Pfeiffer's bacilli, and even meningococci—that stamp the recurrent waves of the epidemic with its bad name.

If we compare the pneumonic complications of influenza with those which arose in the cantonments in 1917–18, first as attendants of measles and later as an independent infection, we note immediately that in both instances the severe effects and high fatalities arose, not from bacteria brought or imposed from without, but from their representatives which are commonly resident upon the membranes of the nose and throat in health. Whatever we may have to learn of the microorganism inducing measles, still undiscovered, and of influenza, still under dispute, and their mode of invasion of the body, no one would question that the bacteria inducing pneumonia are personally borne.

With these various considerations before us we may now discuss the question of the efficiency of our public health measures in diminishing the incidence of epidemic diseases. It should now be evident that our three examples are essentially instances of respiratory infections, that is, diseases in which the inciting microorganism enters the body by way of the air passages, although not necessarily, as in poliomyelitis, directly injuring those parts. Protection in diseases of this class is not to be secured by applying sanitary measures on a wide scale to an extraneous and inanimate source of the infectious microorganism, as to water supplies contaminated with the dejecta of typhoid patients, or even to inferior animal species, such as the mosquito or the rat, which act as intermediaries in conveying the germs of yellow fever or of infectious jaundice; but it is alone to be attained by methods of personal

hygiene, applied on the individual scale of safeguarding one person from another, the most difficult of all hygienic regulations to enforce.

Returning now to epidemic poliomyelitis, we may fairly claim that we are in possession of the essential facts which, if widely applicable, should enable us to control the spread of that disease. But we can, I think, hardly claim that up to the present time our accomplishments in that direction have been remarkable. It is sufficient merely to compare the curve of incidence of the Swedish epidemic of 1905, before the nature and mode of infection of poliomyelitis were known, with those of the last several years in Massachusetts and New York state for example, in order to conclude that the progress of the epidemics in the several places was practically identical.

And, indeed, this is what might be expected in view of the difficulties surrounding the prompt and accurate diagnosis of poliomyelitis in its atypical and abortive, often ambulant forms. Once the disease is introduced under conditions favoring its epidemic spread a wide dissemination of the inciting microorganism takes place, and a constantly increasing number of persons becomes exposed to its presence, before any restrictive measures are put into effect, and indeed also after they have been applied. In the case of poliomyelitis, as in that of influenza itself, a wide distribution of the infectious agent precedes the enforcement of preventive sanitary regulations. These considerations do not, of course, warrant intermission of the protective measures now in use, which undoubtedly save many individuals from exposure and thus from potential attack; they do, however, offer an explanation of why, up to the present time, greater success has not attended efforts at control once the epidemic is under full way.

The case with the epidemic pneumonias is of another order. They represent theoretically two diseases which should respond to methods of control based upon our knowledge of their mode of infection. In the epidemic streptococcus pneumonia and the pneumonia following influenza we are dealing with pathological conditions in which not a newly introduced, extraneous microorganism is operating widely and insidiously, but in which the active microbes concerned are examples merely of intensified races of common and almost omnipresent species belonging to the flora of the nasopharynx. The infectious agents in these instances are contained within the nasal, buccal and bronchial secretions, and are disseminated in the sprayed material which is coughed or otherwise thrown into the surroundings of the patients. The lesson therefore to be derived from the severe experience of the recent pneumonia epidemics is to the effect that measles and influenza patients are not to be assembled into large groups or kept in open wards, but should be placed in separate rooms or cubicles, where they and their attendants may be preserved as far as possible from sputum droplet contamination. In the instance of epidemic pneumonia a chain of direct infection from one patient to another tends to be established, and hence the sanitary control of those diseases is to be sought through the breaking, as it were, of this vicious circle.

A distinction has now been intimated in the possibilities of direct sanitary control between the two epidemic diseases—namely, poliomyelitis and influenza—introduced from without, and the pneumonias, which are mere, if intense, exaggerations of sporadic diseases ordinarily prevailing. I propose now to lay before you a suggestion as to means of attacking the exotic epidemic diseases which may come to merit serious attention.

Epidemic diseases in the commonly accepted sense have fixed locations—the so-called endemic homes of the diseases. In those homes they survive without usually attracting special attention over often long periods of time. But from time to time, and for reasons not entirely clear, these dormant foci of the epidemics take on an unwonted activity, the evidence of which is the more frequent appearance of cases of the particular disease among the native population and sooner or later an extension of the disease beyond its endemic confines. Thus there are excellent reasons for believing that an endemic focus of

poliomyelitis has been established in northwestern Europe from which the recent epidemic waves have emanated.

Similarly, there are excellent reasons for regarding the endemic home of influenza to be eastern Europe and in particular the border region between Russia and Turkestan. Many recorded epidemics have been shown more or less clearly to emanate from that area, while the epidemics of recent history have been traced there with a high degree of conclusiveness. From this eastern home, at intervals usually of two or three decades, a migrating epidemic influenza begins, moving eastward and westward, with the greater velocity in the latter direction.

Now since the combating of these two epidemic diseases, when they become widely and severely pandemical, is attended with such very great difficulty and is of such dubious success, and this notwithstanding the prodigious public contests which are waged against them in which the advantages are all in favor of the invading microorganismal hosts, it would seem as if an effort of central rather than peripheral control might be worth discussing. According to this proposal, an effort at control amounting even to eventual eradication of the diseases in the regions of their endemic survival would be undertaken, an effort indeed not occasional and intensively spasmodic. as during the pandemical excursions, but continuous over relatively long periods, in the hope that the seed beds, as it were, of the diseases might be destroyed.

That such an effort at the eradication of a serious epidemic disease may be carried through successfully the experience with yellow fever abundantly proves. In attacking that disease the combat was not put off until its epidemic spread had begun and until new territory such as New Orleans, Jacksonville, Memphis, etc., had been invaded, but the attack was made on its sources at Havana, Panama and now Guayaquil, to which endemic points the extension into new and neutral territory has been traced.

I do not disregard the essential fact in bringing this suggestion forward, that the control at its sources of yellow fever is quite another and probably far simpler problem than the control in their endemic foci of poliomyelitis and influenza. It is perhaps unnecessary to go far into the reasons why the latter would doubtless prove to be far more difficult of accomplishment than has been the former. I am not now engaged in presenting a plan of operation or proposing that the attempt at eradication be made immediately. Our knowledge of all the facts involved in the epidemiology of poliomyelitis and especially of influenza may still be too imperfect for immediately effective action. But the very magnitude of the problem of these otherwise uncontrollable epidemic diseases invites to an imaginative outlook which, while perhaps nonrealizable to-day, may not, in view of the rapidly advancing knowledge of the infectious diseases, be hopelessly out of reach to-morrow.

Nor am I insensible to the labor and cost in money and talent which the setting out on such an ambitious enterprise would entail. But here at least is a world problem of such proportions and nature as to invite the participation of all the scientifically advanced countries in a common effort to suppress one of the most menacing enemies of civilized man and of human progress.

In proposing to strive for the high achievement, not merely of parrying the blows struck by destructive epidemics, but of rendering them impotent to strike in the future, we may pause for a moment to reflect on the different ways in which peoples react to great calamities, such as those brought by war and by disease. As the results of a cruel and devastating war, revolutions in governments supposed the most stable may occur; no such result follows upon still more devastating epidemics. The recent epidemic of influenza claimed, possibly, more victims than did the great war, and the losses to the world in emotion spent, treasure consumed and progress impeded are incalculable; yet, through a fortuitous circumstance of psychology, from the one calamity the world may emerge chastened, perhaps even bettered, while from the other, because of a depth of ignorance amount-

ing often even to fatalism, mankind may largely miss the deep meaning of the lesson.

Simon Flexner

The Rockefeller Institute for Medical Research

THE NEW INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY[1]

As a result of conferences held in London and Paris in October and November, 1918, the scientific academies of the allied nations decided to recommend the dissolution of all international scientific associations in existence before the war and the reconstitution of such associations by and among the nations associated in the war against the Central Empires. As a result of this recommendation the International Association of Chemical Societies was dissolved and at a conference held in Paris in May of this year definite steps were taken toward the formation of an inter-allied chemical union.

At this conference delegates from the principal allied nations were present. A provisional organization was effected and a committee appointed to draft articles of confederation. M. Moureu, president of the Federated Chemical Societies of France was elected president and M. Gerard, temporary secretary. After drawing up a statement of the purposes of the new organization the Paris conference adjourned and issued a call for a final conference to be held in London, July 14, for the purpose of perfecting the permanent organization and of passing upon the statutes to be prepared by the special committee. In accordance with this action each of the allied countries was invited to send delegates to the London meeting.

This meeting convened in Salters Hall, London, on July 14 last, and continued its sessions until July 18. The countries represented and their delegates were as follows: Belgium—MM. Lucion and Timmermanns; France—MM. Moureu, Kestner, Behal, Marquis, Marie and Gerard; Italy—MM. O. Severini and G. Pirelli; United Kingdom—Sir William Pope, Henry Louis, H. E. Armstrong, E. F. Armstrong, A. C. Chaston-Chapman and W. P. Wynne; United States—F. G. Cottrell, C. L. Parsons, E. W. Washburn and H. S. Washington.

Practically all of the time of the conference was devoted to framing the statutes of the new international organization and the election of the officers for the first three-year term. The following officers were elected:

President—M. Ch. Moureu.

General Secretary—M. Jean Gerard (49 Rue des Mathurins, Paris).

Vice-Presidents—Georges Chavannes (for Belgium), L. Parodi Delfino (for Italy), C. L. Parsons (for the United States), Sir William Pope (for the United Kingdom).

Communications were received from Canada and Poland signifying their adhesion to the new organization and requesting admission. It was also decided to admit the neutral countries immediately, but the admission of the Central Powers was made contingent upon their admission to the League of Nations. The new union is thus to be international in character instead of merely inter-allied.

The conference also voted its approval of the organization of an International Research Council as contemplated by the Conference of Scientific Academies, and expressed its desire to be included in that organization with autonomous powers as the Chemical Section thereof. It was decided to hold the next meeting of the international chemical union in Italy early in June in 1920.

Previous to adjournment the Conference officially appointed those members of its own body who expected to attend the Brussels meeting of the International Research Council as its representatives at that meeting, for the purpose of effecting the union of the new international chemical organization with the International Research Council as its chemical branch.

The delegates thus appointed re-assembled in Brussels on July 22. This meeting was largely devoted to the discussion, modification and final adoption of the statutes of the

[1] Address delivered at the Fifth National Exposition of Chemical Industries at Chicago, September 25, 1919.

new International Union of Pure and Applied Chemistry.

In confirmation of action taken at the London meeting it was voted that a critical compendium of physical and chemical constants should be prepared and published under the auspices of America as part of her contribution toward an international program of documentation which the new union proposed to proceed with as rapidly as possible. The formation of the necessary editorial board for carrying this project into effect and the necessary arrangements for financing it, are now progressing toward completion under the direction of the National Research Council of the United States. This undertaking while primarily under the direction of an American committee which will be charged with complete responsibility, both editorial and financial, will nevertheless be conducted on an international basis with assistant editors and collaborators in the principal nations of the Union. The majority of the delegates felt strongly that in nearly all cases where a program of work was adopted by the Union, the most efficient manner of accomplishing it was to center the responsibility for each part in a given country, rather than to form a central international committee with a consequent distribution of the responsibility.

The purposes of the International Union of Pure and Applied Chemistry and its present composition as set forth in Article I. of the Statutes are as follows:

ARTICLE I

1. Each of the following countries—Belgium, United States of America, France, United Kingdom of Great Britain and Ireland, and Italy, through the agency of its National Research Council (Chemistry Division), or its Federal Council of Chemistry, on failing such national federation, through the agency of a national chemistry association—joins with the others in the formation of an International Union of Pure and Applied Chemistry, having for its objects the following:

(*a*) To cement among the allied peoples the bonds of friendship and mutual esteem which have been developed and strengthened during the course of the war.

(*b*) To organize permanent cooperation between the chemical associations of the different countries.

(*c*) To coordinate their scientific and technical activities.

(*d*) To contribute to the advancement of chemistry in all its branches.

2. The Union thus constituted shall be perpetual. Its provisional headquarters shall be in Paris.

The admission of a nation to the Union is effected through some organization within that nation which substantially constitutes a federation of the principal chemical societies of the country. Thus the United Kingdom of Great Britain and Ireland joined the Union through her Federal Council for Pure and Applied Chemistry, France joined through her Federation Nationale des Associations de Chemie Pure et Appliquée, Italy through her Associazone Italiana di Chimica Generale ed Applicata and the United States of America through the Division of Chemistry and Chemical Technology of the National Research Council. Ultimately it is the expectation that in each nation there will be formed a National Research Council somewhat similar to our own and when this is formed, the National Chemical Federation will become merged with it as the chemical division.

The voting strengths, number of delegates and financial contributions of the countries belonging to the Union are fixed in accordance with six categories determined by population. The new Union is to be administered by a Council composed of the delegates of the constituent countries and between meetings of the Council by the Committee of Officers, composed of the president, the four vice-presidents and the general secretary. The statutes also provide that annual meetings of the Union shall be held. The other provisions of the statutes have to do principally with the machinery of operation, method of voting, financial provision conduct of meetings, duties of the officers, etc.

Owing to the fact that the drawing up and adoption of the statutes consumed practically all of the time of the delegates both at the London and at the Brussels meeting, there was practically no opportunity to consider at length the various projects which the Union should undertake and it is therefore probable that the Rome meeting will be devoted largely to drawing up a program of work.

The fact that the new Union is a union of national federations in a position to act for all the chemical interests of the countries which they represent, and having frequent meetings throughout the year, should make it possible for this new international organization to function more efficiently than the previous International Association of Chemical Societies, and it is hoped that the new organization will accomplish valuable work for the science and for the chemists of the world.

Edward W. Washburn,
Acting Secretary of the American Delegation

STATUTES OF THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY (FREE TRANSLATION OF THE FRENCH TEXT)

Article I

1. Each of the following countries—Belgium, United States of America, France, United Kingdom of Great Britain and Ireland, and Italy, through the agency of its National Research Council (Chemistry Division), or its Federal Council of Chemistry, or failing such national federation, through the agency of a national chemistry association—joins with the others in the formation of an International Union of Pure and Applied Chemistry, having for its objects the following:

(*a*) To cement among the allied peoples the bonds of friendship and mutual esteem which have been developed and strengthened during the course of the war.

(*b*) To organize permanent cooperation between the chemical associations of the different countries.

(*c*) To coordinate their scientific and technical activities.

(*d*) To contribute to the advancement of chemistry in all its branches.

2. The Union thus constituted shall be perpetual. Its provisional headquarters shall be in Paris.

Article II

1. The conditions governing the admission of a country to the Union shall conform to those fixed by the statutes of the International Research Council.

2. A country may join the Union through its "national chemical federation," *e. g.*, through its National Research Council (Chemistry Division), or through its Federated Council of Chemistry, or failing such organization, through a national association representing chemistry. (*Translator's Note.*—The purpose of this paragraph is to provide for the formation in each country of some national agency which shall federate all of the major chemical organizations of the country. Thus in the United States this federation is effected through the Chemistry Division of the National Research Council, while in England it is effected through her Federal Council of Chemistry. Ultimately it is expected that in each country the federating agency will become merged in the National Research Council of that country in the capacity of its Chemistry Division.)

Article III

1. The functions of the Union as set forth in Article I. shall be exercised through a council, assisted by an administrative secretary and by a special staff or bureau, the establishment and duties of which shall be determined by international agreement among the constituent countries.

Article IV

1. The annual subscription for each country is fixed at a rate dependent upon the number of its inhabitants, in accordance with the following categories:

	Population in Millions of Inhabitants	Minimum Annual Subscription
Category A	less than 5	500 francs
" B	from 5 to 10	1,000 "
" C	from 10 to 15	1,500 "
" D	from 15 to 20	2,000 "
" E	from 20 to 30	2,500 "
" F	more than 30	3,000 "

2. The inhabitants of any non-self-governing colonies or protectorates of a country may, at the discretion of that country and in accordance with its own census data, be counted with its own inhabitants.

3. No member of the Union may without its own consent be assessed by the Union to provide funds for other than general administrative expenses.

Article V

1. Any member of the Union may withdraw therefrom, provided said member shall have fulfilled all of its current obligations.

2. A member of the Union may be expelled or dropped from membership by a three fourths vote of the members of the council, either present or represented, for non-payment of the minimum annual subscription or for a serious offense, the member having previously been called upon to furnish explanations.

Article VI

1. The Union shall be administered by a council composed of the delegates of the constituent countries, the numbers and distribution of such delegates to be determined by the categories of Article IV. in accordance with the following table:

		Delegates
Category	A	1
"	B	2
"	C	3
"	D	4
"	E	5
"	F	6

2. These delegates shall be appointed for a term of three years by the "National Chemical Federation" of the respective countries. One third of the membership of the council shall retire annually but the retiring members shall be eligible for reappointment.

Article VII

1. The executive functions of the council shall be exercised through a committee of the officers which shall be a president, four vice-presidents, and a general secretary. These officers shall be elected by the council from among its own membership by a majority vote. They shall serve for terms of three years, and with the exception of the general secretary shall not be eligible for immediate reelection to the same office. The president shall be chosen from among the vice-presidents.

Article VIII

1. The council shall meet at least once a year on the day before the annual general meeting in the town where the latter is to be held, and, in addition, as often as it shall be convened by its president, or upon the requisition of one fourth of its members.

2. The council shall fix the date and place of meeting, draw up the budget, and decide as to expenses.

3. Resolutions shall be adopted by a majority.

4. On questions of an administrative or financial nature the voting shall be by countries, each country having a number of votes equal to the number of its delegates. In such voting it is, however, not necessary that all these delegates be present. The delegates of any country may appoint one or several proxies to represent them and to vote in their name.

5. Voting by correspondence is permitted.

6. All questions to be voted upon must appear on the agenda of the meeting.

7. The president shall have the casting vote in case of a tie.

Article IX

1. Minutes shall be kept of all meetings. Two copies of the minutes shall be prepared and signed by the chairman and the secretaries of the meeting.

2. The permanent secretarial staff shall have the custody of the archives, and shall be entrusted with the execution of the decisions taken by the council and by the committee of officers and in particular with the circulation of the agenda.

Article X

1. The functions of the committee of officers shall be:

(*a*) To see that the rules are strictly observed.

(*b*) To prepare the agenda for meetings of the council.

(*c*) To record and carry out the decisions of the council.

(*d*) To perform during the entire period elapsing between two meetings of the council the necessary acts of administration and to report the same in writing to the members of the council.

(*e*) To submit to the council a draft yearly budget.

(*f*) To represent the Union or to appoint its representatives.

Article XI

1. There shall be instituted, in addition to the council, a consultative committee, consisting of as many sections as shall be necessary to ensure the complete representation of pure and applied chemistry in conformity with the regulations of the Union.

Article XII

1. The general assembly of the Union shall consist of the members of the council and of the delegates of the "National Chemical Federations" of the constituent countries.

2. A regular meeting of the general assembly shall be held at least once a year, preferably at the time and place of the meeting of the International Congress of Pure and Applied Chemistry.

3. The general assembly shall also meet when called together by the council or when such a meeting is requested by at least one half of the members of the Union.

4. The general assembly shall receive reports on the administrative work of the council on its financial situation, and on the general condition of the Union.

5. It shall approve the accounts of the previous fiscal year as certified by an auditor, selected from outside the membership of the council and appointed by the general assembly of the preceding year.

6. It shall pass upon the budget for the next fiscal year and shall discuss those questions appearing upon its agenda.

7. The annual report and the accounts shall be sent each year to all the members three months in advance of the annual meeting of the general assembly. The agenda of the general assembly shall be drawn up by the council and must include every question which shall have been transmitted to it by any of the members of the Union three months in advance of the meeting of the general assembly.

8. The officers and executive committee of the general assembly shall be identical with those of the council.

9. Votes on administrative and financial questions shall be cast by countries, each country having the number of votes indicated in the categories of Article VI.

10. The delegates of any country may appoint one or several proxies to represent them and to vote in their name.

Article XIII

1. All expenditures shall be authorized by the president and disbursed through the administrative secretary.

2. The spokesman and representative of the Union before the public and in all legal matters and court proceedings shall be its president, who may, however, delegate his powers in this respect to the administrative secretary or to any member of the council.

Article XIV

1. Resolutions of the council relating to such purchases, exchanges, and transfer of real property as may be needed for the accomplishment of the objects of the Union, grant of mortgages on the said properties, leases for more than nine years, transfers of properties and loans, must be submitted to the general assembly for approval.

Article XV

1. Amendments to these statutes may be considered and voted upon by the general assembly only when submitted thereto by the council of the Union or proposed by a "national chemical federation" of one of its constituent countries. All such proposed amendments shall appear upon the agenda of the meeting of the general assembly, provided they have been received in writing by the committee of officers at least three months in advance of the meeting.

2. Voting upon amendments shall be by countries in accordance with the categories of Article VI.

3. Voting by correspondence is permitted.

4. The statutes may be amended only by a two thirds majority of the votes cast.

Article XVI

1. In the event of a meeting of the general assembly being convened to decide upon the dissolution of the Union, special notices to that effect shall be sent three months in advance; and at least three quarters of the members of the Union or their proxies must be present. If this proportion is not reached, the general assembly shall be adjourned for not less than six months, when the decision of the adjourned meeting shall be operative, irrespective of the number of members present.

In any case, dissolution can only be resolved upon by a majority of two thirds of the votes cast.

Article XVII

1. In the event of dissolution the general assembly shall appoint one or more trustees to liquidate the property of the Union; and any surplus assets shall be donated to an international institution.

Article XVIII

1. In the interpretation of these statutes the French text shall be authoritative.

EDWARD W. WASHBURN,
Acting secretary of the American Delegation

SCIENTIFIC EVENTS

GIFT FOR THE IMPROVEMENT OF MEDICAL EDUCATION IN THE UNITED STATES

JOHN D. ROCKEFELLER has given to the General Education Board, founded by him in 1902, $20,000,000, to be used for the improve-

ment of medical education in the United States. The following announcement has been made:

"The General Education Board announces a gift from John D. Rockefeller of twenty millions of dollars, the income to be currently used and the entire principal to be distributed within fifty years for the improvement of medical education in the United States."

The working capital previous to this accretion amounted to between $35,000,000 and $40,000,000. Since the present sum is to be devoted exclusively to medical education, whereas the board's previous resources, under the terms of the charter granted it by Congress, have been devoted to "promoting education within the United States, without distinction of race, creed or sex," the activities of the organization with respect to medical teaching will be greatly increased.

The board will meet in December, at which time a detailed program with respect to medical education will be mapped out.

Mr. Abraham Flexner, secretary of the board, stated in a general way that just as the board in the past out of its general funds has made considerable donations to the treasuries of medical schools of such universities as Yale, Johns Hopkins, Chicago and Washington in St. Louis, it will, as soon as its plans are worked out, spend large sums for the improvement of the hospital facilities, the teaching staffs and the laboratory facilities of such schools as are decided to be worthy of help. It was pointed out that under the terms of the gift while the entire principal must be distributed within fifty years, there is nothing to prevent the concurrent distribution of both principal and interest and this, he said, undoubtedly would be done.

Mr. Flexner stated that there would be a general survey of the schools of the country which would determine not only which ones could be improved, but also what were the specific needs in each instance. The needs of all parts of the country would be taken into consideration in apportioning such sums as it is decided to disburse from the fund.

LECTURES ON POPULAR SCIENCE AT THE UNIVERSITY OF CALIFORNIA

The Sunday afternoon lectures on popular science topics given the research men of the University of California and Stanford University and the local representatives of the various United States Bureaus under the auspices of the California Academy of Sciences in the Museum in Golden Gate Park are serving a good purpose in bringing into closer relations the scientific expert and the public. The following illustrated lectures have been announced:

October 12: Dr. Walter P. Taylor, assistant biologist, United States Biological Survey, Washington, D. C., on "The flora and fauna of Mount Rainier."

October 19: Mr. C. A. Kupfer, forest investigator, United States Forest Service, San Francisco, on "California's future; what the Forest Service is doing to determine and meet the coming demands for timber and other National Forest resources."

October 26: Mr. R. F. Hammatt, in charge information, United States Forest Service, San Francisco on "Some forestry problems, both government and private."

November 2: Mr. F. D. Douthitt, grazing examiner, United States Forest Service, San Francisco, on "Range management on the National Forests in California."

November 9: Mr. Don P. Johnston, assistant district forester, United States Forest Service, San Francisco, on "Industrial research in the Forest Service."

THE AMERICAN SOCIETY OF NATURALISTS

The American Society of Naturalists will hold its thirty-seventh annual meeting at Princeton University, on Tuesday and Wednesday, December 30 and 31. The society will offer, beginning on Tuesday morning, December 30, a program to which its members are invited to contribute papers.

A symposium on "Some Relations of Biology to Human Welfare" will be presented on Tuesday afternoon.

The Naturalists' dinner will be held on the evening of Tuesday. At the close of the dinner Edward M. East will give an address entitled "Population."

Titles of papers offered by members of the society, with estimated length of delivery and statement of lantern or chart requirements, must be in the hands of the secretary by December 1. It is desired that papers be short and it should be remembered that the interests of the Naturalists are primarily in problems of organic evolution. The papers on the program will in general be arranged in order of the receipt of title except that papers on similar subjects may be grouped.

Attention is called to the change in the constitution by which a nomination for membership must now remain in the hands of the executive committee for at least one year before action can be taken upon it. Therefore, nominations to receive attention in 1920 must reach the secretary by December 31, 1919. Blank forms for nomination may be obtained from the secretary, Bradley M. Davis, Botanical Laboratory, University of Michigan, Ann Arbor, Mich.

AWARD OF THE WILLARD GIBBS MEDAL

THE Willard Gibbs gold medal was presented on September 26 to Professor William A. Noyes, director of the department of chemistry at the University of Illinois, for special work in chemistry for the government performed during the war.

The presentation was made following a reception and dinner to Professor Noyes by more than four hundred of the country's leading chemists and educators, who were in attendance at the Fifth National Exposition of Chemical Industries, held at the Coliseum, Chicago. The presentation speech was made by Dr. William H. Nichols, of New York, president of the American Chemical Society, following a brief history of the achievements of Dr. Noyes by L. V. Redman, of Chicago.

Dr. Harry Pratt Judson, president of the University of Chicago; Dr. W. E. Stone, president of Purdue University; Dr. Ira Remsen, past president of Johns Hopkins University; Dr. David Kinley, acting president of the University of Illinois, and Harry H. Merrick, president of the Chicago Association of Commerce, gave short addresses, pointing out the prominence which American science has attained in the chemical work, and of the successful efforts now under way to apply the thousands of war secrets to commercial uses.

SCIENTIFIC NOTES AND NEWS

DR. W. A. HERDMAN, professor of zoology in the University of Liverpool, who has been general secretary of the British Association for the Advancement of Science since 1903, has been elected president of the association.

THE Triennial Council of the United Chapters of Phi Beta Kappa elected at the recent meeting at Harvard University as the new president of the United Chapters for the term, 1919–22, President E. A. Birge, of the University of Wisconsin. He succeeds Professor E. A. Grosvenor, of Amherst College.

DR. HUGH CABOT, professor in the Harvard Medical School and chief surgeon at the Massachusetts General Hospital, has been appointed chief surgeon of the University of Michigan. He expects to take up his new work about January 1.

DR. ISADORE DYER has been appointed a colonel in the Medical Section, Officers' Reserve Corps. Dr. Dyer was made a member of the Council on Medical Education of the American Medical Association at the meeting of that organization held in Atlantic City in June.

DR. C. LEO MEES resigned as president of Rose Polytechnic Institute on September 1, and retires on a pension under the Carnegie Foundation, at the age of sixty-six, his retirement being due chiefly to impaired health. President Mees has been a teacher for forty-four years, thirty-two of which have been spent at Rose. For seven years he served as professor of physics, and for twenty-five years as president. He has been appointed president emeritus by the board of managers.

DR. F. C. BROWN has resigned his position as associate professor of physics, University of Iowa, and accepted a position as technical assistant to the director of the Bureau of Standards. He has, during the war, been doing scientific work in connection with aircraft

armament problems of the Ordnance Department as major in the U. S. Army.

Professor Bailey Willis, who succeeded Dr. Branner in the department of geology at Stanford University, will hereafter be in residence from January to June only, and will devote the balance of the year to geologic research and field work.

Professor Daniel Starch, of the University of Wisconsin, is on leave of absence for the first half of the present year. He is giving a three-hour course of lectures during the semester at Harvard University.

Dr. James W. Glover, professor of mathematics and insurance at the University of Michigan, spent the month of September in New York City, serving as acting president of the Teachers Insurance and Annuity Association of America. Professor Glover is a member of the board of trustees and acted for Dr. Henry S. Pritchett, who is spending the summer in the west.

Dr. R. H. Sylvester, clinical psychologist at the Iowa State University, Iowa City, has been selected as chief of the health center at Des Moines, with headquarters in the court house.

The Pontécoulant Prize of the Paris Academy of Sciences has been awarded to Professor A. S. Eddington for his astronomical researches.

Dr. Barton Warren Evermann, director of the museum of the California Academy of Sciences, with Dr. John Van Denburgh, the herpetologist, left San Francisco on September 11, for the Olympic Mountains in Washington. The party will be joined in Seattle by Mr. C. J. Albrecht, director of vertebrate exhibits of the Washington State Museum, and a photographer, and an effort will be made to obtain motion pictures of the Roosevelt Elk in their native haunts in these mountains. The films if successful will be used to supplement the story told by the habitat group of Roosevelt Elk, now being installed in the Academy's Museum in Golden Gate Park, through the munificence of Captain William C. Van Antwerp.

We learn from *Economic Geology* that T. Wayland Vaughan, D. Dale Condit, C. Wythe Cooke and Clyde P. Ross, of the U. S. Geological Survey, have recently returned to Washington after spending several months in a reconnaissance of the Dominican Republic, for the Dominican government. Dr. Vaughan also visited Prince au Prince, Haiti, and made arrangements with the Haitian government for a preliminary geological survey of Haiti. He later made a reconnaissance in the Virgin Islands at the request of the Navy Department. Mr. Condit, who was in charge of the field work in Santo Domingo, has in preparation several reports one of which, soon to be published, will describe the results of geologic work in Barahona and Azua Provinces.

The James Watt centenary celebrations in Birmingham were opened with lectures by Professor F. W. Burstall and Professor Hele-Shaw on September 10. In the afternoon there was a memorial service at Handsworth Parish Church, in which Watt, Boulton and Murdoch were buried, an address being delivered by Canon E. W. Barnes, Master of the Temple. This was followed by a garden-party at Heathfield Hall, and a reception by the Lord Mayor at the Council House. The following day lectures were given by Sir Oliver Lodge, Professor Alex. Barr and Professor J. D. Cormack, and in the afternoon visits were made to some of Watt's engines. In the evening the centenary dinner was held. The university held a special Degree Congregation to confer honorary degrees on the American Ambassador (the Honorable J. W. Davies), Sir Charles Parsons, Vice-Admiral Goodwin, M. Rateau (of Paris), Sir George Beilby, Colonel Blackett, Professor Barr and Mr. F. W. Lanchester.

The death is announced on August 5 of Mr. W. D. Dallas, who was scientific assistant to the meteorological reporter to the government of India from 1882 to 1906.

The *Deutsche medizinische Wochenschrift* of May 29, as quoted by the *Journal* of the American Medical Association, gives the total losses of Germany as 6,873,415. This includes

the 615,922 soldiers held prisoners of war in other lands, and the 4,207,023 wounded. The dead numbered 1,676,696, and the missing most of whom are presumably dead, 373,770, a total of 2,000,000 killed in the war.

UNIVERSITY AND EDUCATIONAL NEWS

THE will of General Horace W. Carpentier has now been filed. The estate is valued at $3,606,000. The principal beneficiaries are Columbia University and Barnard College, each of which receives $1,420,000. Other beneficiaries include the Presbyterian Hospital, $200,000; Sloan Hospital, $200,000, and the University of California, $100,000.

BY the will of the late Charles W. Lenney, of New York, $50,000 is left to Boston University.

MR. ARTHUR BALFOUR has been nominated for election as chancellor of Cambridge University, in succession to his brother-in-law, the late Lord Rayleigh.

COLORADO COLLEGE has again opened its forestry school, which was closed for two years because of the war. Mr. J. Gordon Parker has been appointed assistant professor of forestry in charge of the school.

A NEW department of physiological chemistry has recently been established at the University of Kansas. Dr. C. Ferdinand Nelson has been elected professor of biological chemistry and head of department.

AT Yale University Arthur Phillips, M.S., has been appointed assistant professor of metallurgy, in the Sheffield Scientific School; James Albert Honeij, M.D., at present assistant professor, professor of clinical medicine in charge of radiology, and Wilder Tileston, M.D., at present assistant professor of medicine, professor of clinical medicine.

DR. C. W. HEWLETT, professor of physics in the North Carolina College for Women, Greensboro, N. C., has been appointed assistant professor of physics at the University of Iowa.

RECENT appointments in the medical school of Loyola University, Chicago, are as follows: S. A. Matthews, M.D., professor and head of the department of physiology, pharmacology and therapeutics; A. C. Ivy, A.M., Ph.D., formerly instructor in physiology at the University of Chicago, associate professor in physiology; E. S. Maxwell, formerly instructor in pathology at Vanderbilt University and more recently first lieutenant in the U. S. Medical Corps, associate professor in bacteriology and pathology.

DR. HARRISON R. HUNT has resigned as assistant professor of zoology at West Virginia University to become head of the department of biology at the University of Mississippi, Oxford, Mississippi.

DR. J. W. SHIPLEY, professor of chemistry in the Manitoba Agricultural College, has resigned his position in order to accept an appointment as assistant professor in chemistry in the University of Manitoba.

DISCUSSION AND CORRESPONDENCE

THE RIGIDITY OF THE EARTH

TO THE EDITOR OF SCIENCE: An account of an experiment to determine the rigidity of the earth was published in *The Astrophysical Journal* and in *The Journal of Geology*, March, 1914 and in SCIENCE, June 26, 1914. This gave the ratios of the amplitudes of tides observed in N.–S. and E.–W. pipes to the amplitudes computed for the same pipes on the assumption of a perfectly rigid earth, as .523 and .710 respectively.

The work of reducing a new set of automatically recorded observations made by an interference method, which was interrupted by the war, was recently resumed, and it was found that the N.–S. and E.–W. ratios were very nearly equal to each other.

It was then noted that $\frac{.523}{.710} = .7366$ and that the cosine of the latitude of Yerkes Observatory, where the experiment was performed, is .7363. It seemed highly probable therefore that $\cos\phi$ had been introduced erroneously into the computed formula far the N.–S. tides.

We have just been informed by Professor

Moulton that he has gone over the old formulæ used and has found that the computer introduced the factor $\cos\phi$ erroneously into the N.–S. computation.

The N.–S. ratio should therefore have been $\frac{.523}{.7363} = .710$, which oddly enough is exactly equal to the E.–W. ratio.

The new observations point to a value of about .69 for both E.–W. and N.–S. ratios.

A. A. MICHELSON,
HENRY G. GALE
THE UNIVERSITY OF CHICAGO,
September 10, 1919

AN UNUSUAL MIRAGE

MOST people are probably familiar with the type of mirage often seen over paved streets on still hot days. In its simplest and most common form one appears to see merely a wetted portion of the pavement some distance ahead. In more striking cases this assumes the appearance of a pool of water in which buildings, trees and vehicles are seen reflected. As is well known this is due to the presence just above the pavement of a layer of air which being warmer than that above it is lighter and hence has a lower index of refraction than the air a little distance from the surface of the earth. These mirages are oftenest seen in mid-afternoon, and when motoring through the country such a pool often appears to continually recede and thus remains in sight for a long time. Recently while traveling from San Francisco to Portland with Professor W. C. Morgan we encountered such a mirage under rather unusual conditions.

The section of the Pacific Highway which traverses the Sacramento valley being paved with cement and under a hot sun is an ideal place for such mirages which had been visible much of the afternoon. Just after dusk (about nine o'clock) a car with powerful lights came over a slight rise a mile or so ahead. A moment later the lights of a second car appeared some distance in front of the first as though the driver had just turned them on. These lights were about half as brilliant as those of the first car and the impression was that two cars were approaching—a small one followed by a larger one. The large car was seen to gradually overtake the small one until finally the two sets of lights coalesced and a minute later we met and passed—a single car. "I thought there were two of them," said Dr. Morgan. So did I. We had seen a mirage at night.

A. A. KNOWLTON
REED COLLEGE

QUOTATIONS

THE ROCKEFELLER FOUNDATION

A REVIEW of the work of the Rochefeller Foundation in various countries during 1918 by the president, Mr. George E. Vincent, shows that its activities extended literally from China to Peru. The foundation has shown practical interest in advanced medical education in hygiene in two ways. In the first place it has by gifts for building, equipment, and maintenance, rendered possible the opening last October of the school of hygiene and public health at Johns Hopkins University in Baltimore. In the second place it has, since 1915, followed the policy of granting a number of international fellowships and scholarships to students from foreign countries and American missionaries at home on leave. In 1918 there were 68 fellowships and scholarships distributed as follows: Brazilian physicians 3, Chinese graduate physicians 11, Chinese undergraduate medical students (formerly students of the Harvard Medical School of China) 10, Chinese pharmacists 3, Chinese nurses 6, medical missionaries on furlough 26, candidates under consideration for the new schools at Peking and Shanghai 9. The International Health Board has adopted a system of "study leave," by which members of its staff of medical officers, now nearly 60 in number, may, under favorable conditions of salary, pursue at the expense of the board special courses in public health at leading American or foreign institutions. In this way the equivalent of additional graduate fellowships has been created. Provision was also made for the bringing to the United States French medical men for special train-

ing in antituberculosis measures, but no appointments were actually made in 1918. A commission for the prevention of tuberculosis, at the head of which was Dr. Livingston Farrand, opened a campaign in France in July, 1917. Although there were in existence examples of every agency effective in combating tuberculosis, they were few in number and there was no centralized organization for a combined attack on the disease. The commission, in cooperation with the Tuberculosis Bureau of the American Red Cross, set about demonstrating the value of "team play" by organizing and coordinating the essential agencies. In 1918 four central dispensaries and six secondary centers were opened. Nurses attached to these centers visited patients at their homes; the Red Cross provided hospital accommodation, opened sanatoriums, and supplied food and clothing. Efforts were made to establish local committees in the leading towns. At the time of the first visit twenty-one dispensaries were in existence in twenty-seven departments. By the end of the year fifty-seven new dispensaries had been opened, twenty others were in process of installation, and plans had been agreed upon for forty-nine more. Besides these dispensaries, fifteen laboratories were in course of establishment and forty new committees organized. An active propaganda was carried on throughout the country by means of "tanks," posters, lectures, demonstrations, pamphlets, postcards, exhibits and games. The services of the press and of art were enlisted as agents in the education of the people. The Foundation has also made experiments in the control of malaria. In four towns in Arkansas measures for the extermination of anopheline mosquitos were carried out with marked success. By draining and filling pools, ditching sluggish streams, and oiling surface water, the breeding of the insect was almost entirely prevented. The results were striking. In Hamburg, Arkansas, the number of visits paid by doctors to patients suffering from malaria fell from 2,312 in 1916 to 259 in 1917 and to 59 in 1918, a reduction for the period of 97.4 per cent. In four other communities the percentage of reductions varied from 95.4 to 80 per cent. In Sunflower county, Mississippi, it was believed that a malaria control of 80 per cent. was achieved. In regions where surface water can not be dealt with "carriers" are looked for and treated. In Guatemala an epidemic of yellow fever was checked. Work for the relief and control of hookworm disease was carried out in cooperation with twelve states of the union and with twenty-one foreign countries. In China the construction of the fifteen buildings of the Peking Union Medical College College was steadily proceeded with in 1918. An account of this institution was given in the *British Medical Journal* of August 2, 1919. On account of the glazed green tiles used to cover the roofs the College is called by the Chinese "the Green City."—*The British Medical Journal.*

SCIENTIFIC BOOKS

Life Histories of North American Diving Birds, Order Pygopodes. By Arthur Cleveland Bent. Bull. 107, U. S. Nat. Mus., August 1, 1919. Pp. i–xiii; 1–245; Pls. 1–55.

Since the discontinuance of Major Charles E. Bendire's "Life Histories of North American Birds" there has appeared no comprehensive work on this subject. Students of the life and behavior of most North American birds have been much handicapped by the lack of published information, and the widely scattered character of such as is available. In preparing a biography of a North American bird it is frequently still necessary to turn back to the works of Audubon and Wilson for data. In few groups is this lack more evident than in those that form the subject of the present work, *i. e.*, the three families, Colymbidæ (grebes), Gaviidæ (loons), and Alcidæ (auks), unwisely associated in the "Order" Pygopodes of the classification of the Check-List of the American Ornithologists' Union.

The present author has done science a service by bringing together and presenting in serviceable form the obtainable data on these groups of birds. From a large number of ornithologists to whom due acknowledgment is made, the author has received original con-

tributions or other assistance. The geographic distribution of the various species has been largely compiled by Dr. Louis B. Bishop and Mr. F. Seymour Hersey, while the biographies of two species—*Fratercula arctica arctica* and *Plautus impennis*, have been written by Dr. Charles W. Townsend. An effort has been made to have the account of each species as complete as possible, and judicious quotations from literature have been used whenever original information was not available; yet, as is with naïve modesty said in the author's introduction, "No one is so well aware of the many shortcomings and omissions in this work as the author. Allowance must be made for the magnitude of the undertaking. If the reader fails to find mentioned in these pages some things which he knows about the birds, he can blame himself for not having sent them to the author."

The method of treatment is decidedly modern, and facilitates reference to any portion of the information presented. Each one of the 36 species and subspecies is treated separately, but undue repetition is avoided under subspecies. These individual biographies range in length from less than two to nearly thirteen pages, and, notwithstanding their scientific accuracy, are for the most part pleasantly written. The account of the loon (*Gavia immer*) is particularly interesting. We are sorry to see, however, that the author still retains the possessive case for common names of birds dedicated to individuals.

The data under each species is arranged in two general categories, "Habits" and "Distribution." Under the former the subheadings are arranged, it will be noticed, as far as possible according to the sequence of the seasons. "Spring," "Courtship," "Nesting," "Eggs," "Young," "Plumages," "Food," "Behavior," "Fall," and "Winter." Under "Distribution" appear "Breeding Range," "Winter Range," "Spring Migration," "Fall Migration," "Casual Records," and "Egg Dates." Of course, owing to the lack of information, all these headings are not to be found under every species. An introductory paragraph under "Habits" gives general information that could not be satisfactorily distributed under the subheadings.

Under "Spring" general information is given regarding spring migration and habits during this period and until the breeding season, except that relating to courtship, which is reserved for a special paragraph. "Nesting" includes the dates of breeding, the location and description of the nest and its environment, and the habits of the species during this period. The paragraph on eggs concerns their number, character, color, dimensions, incubation, and similar facts. The section devoted to the young gives principally their habits until they are able to take care of themselves, together with the manner in which their parents provide for them. Under the heading "Plumages" there is a great deal of original and valuable information, including more or less complete descriptions of the various stages of plumage and succession of molts from that of the nestling to that of the adult, which in the birds covered by the present contribution has been little understood. Under "Food" there is given a résumé of the present knowledge of the kinds of food and their relative importance, together with notes on feeding habits. Under "Behavior" there is a general account of the various activities of the birds, particularly their flight, swimming and diving habits, vocal powers, general actions, and their enemies. The paragraph headed "Fall" concerns chiefly the autumn migration and the habits of birds during this period; and that relating to "Winter" contains similar data.

The information regarding geographic distribution has evidently been worked out with considerable care, and is one of the most valuable parts of this bulletin. For this purpose indebtedness is acknowledged to the files of data in the Biological Survey of the United States Department of Agriculture. The breeding range is given in considerable detail and, as we like to see it, with the limits in each direction outlined. The same is true of the winter range. In "Spring Migration" and "Fall Migration" no general statement of routes is given, but simply various data of arrival and departure at different points through-

out the North American ranges of the species. The casual records are added separately, but, we regret to see, with altogether too little specific data. The egg dates are generalized records taken from a great mass of data and are usually given for one or two states with only inclusive dates.

Disclaiming any attempt at critical treatment of the questions of relationship, our author, however, occassionally adds comments of this character. One of the most interesting of these relates to that peculiar form *Uria ringvia,* which some ornithologists consider a distinct species, and others a mere aberration of *Uria troille.* Mr. Bent presents the data on both sides of this question, but seems to think that the bird is a distinct species. Other important critical remarks are given under *Gavia arctica arctica,* which is shown to be extralimital so far as North America is concerned. The records ascribed to this are considered all properly referable to the recently described *Gavia viridigularis* Dwight, which is here treated as a subspecies of the European *Gavia arctica.*

"The Life Histories of North American Diving Birds" is unusually well illustrated. The 43 black and white full-page plates represent nearly twice that many scenes in the life of the various species, and consist of half tones showing habitat, nests, eggs, young, and sometimes also adult birds; many of these are of much scientific interest and add greatly to the instructiveness and interest of the book. The 12 colored plates represent the eggs of many of the species. These are apparently of natural size, but there is, unfortunately, no indication on the plates or elsewhere that this is the case.

It is manifestly impossible in the brief space of a review to do justice to this work, crowded as its pages are with information; but one thing we may say, and with truth, that "The Life Histories of North American Diving Birds" is one of the most important contributions to North American ornithology, and will for a long time be the recognized authority on biography of the species that it treats.

Harry C. Oberholser

SPECIAL ARTICLES

VISIBILITY OF BRIGHT LINES

There has been a material amount of investigation regarding the visibility of dark lines against a light background. Seeing a linear object is much easier than seeing a spot of similar minimum dimension, and totally different from resolving parallel lines, which must be distinct as a whole before there is the least chance of resolution. In general terms distinct lines or spots can, with difficulty, be resolved when distant 1′, to judge from the average of many experiments,[1] depending on relative contrast of the objects and other experimental conditions, and barring occasional cases of highly abnormal acuity, $V = 5$–8, such as those reported by Cohn.[2] A single spot, white on black or black on white can be detected by one with fairly keen vision down to a diameter of 30″, by an occasional observer to half this value, again depending on conditions and background, with some advantage on the side of white on black as being less adversely affected by irradiation. A careful distinction should be drawn between the case here considered of contrasted bodies returning light diffusely, and that of directed specular reflection as from a mirror reflecting the sun. This latter visibility, as in the observation of a star, seems to depend chiefly on the minimum stimulus value for the retina under the existing conditions of adaptation. Humboldt records in his "Cosmos" the observation of a heliograph mirror when subtending an angle of only 0″.43, and Professor Hosmer (M.I.T.) tells me that his students could readily pick up signals from a very small heliograph at about 20 miles—angle subtended a scant 0″.2.

Some experiments by Barnard[3] with a dark wire 0″.009 inch in diameter showed that it was visible when suspended against moderately bright sky up to 356 feet, angle subtended 0″.44. a figure down to something like 1/60 the diameter of the smallest spot ordinarily visible.

[1] Nagel, "Handbuch d. Physiologie d. Menschen," III., 340.

[2] *Berl. Klin. Woch.,* 1898, 20–22.

[3] *Pop. Ast.,* 1898, p. 1.

Later Lowell[4] tried out a similar experiment with the result of finding his wire visible easily at 0''.89, with some difficulty at 0''.83 and glimpsed down to 0''.69. Evidently his contrast conditions were less good than Barnard's. A further test by Slipher and Lampland[5] showed the wire disappearing from certain vision at 0''.86, while a dark blue line on a white disk held down to 0''.83. W. H. Pickering[6] experimenting with a dark human hair against open sky found it easily visible when subtending an angle of 1''.13, easily glimpsed at 0''.97, occasionally glimpsed at 0''.83, and quite invisible at 0''.72.

Taking up the converse case the writer first tried a German silver wire 0.01 inch diameter stretched zigzag in lengths of several feet over a dark plank bulkhead. The reflectivity of this varied from about 0.06 to 0.12, *i. e.*, a very dark gray. The test was in full sunshine and the observers, the place being the range of the Massachusetts Rifle Association, were a group of riflemen, keen of sight and experienced in close observation. The terrain was laid off in 50-foot spaces and the results were as follows: Wire vanished across lighter parts of background at 75 feet (2''.3) while across the darkest of that background the wire persisted up to 200–250 feet, beyond which it was invisible save for specular glints especially at twists. To summarize:

Angular Diameter	Appearance
1''.11	Parts against dark background were plain.
0''.86	Portions seem distinctly but not steadily.
0''.69	Visible at specular spots, difficultly glimpsed elsewhere.
0''.46	Visible by specular reflection only.

A second test with some of the same observers was made, using a background of black paper (coefficient .045), white thread 0.008 inch in diameter, and drawn tungsten wire 0.005 diameter. The paper was nailed to the former bulkhead and wire and thread stretched zigzag as before. Observed in bright skylight, also in moderately bright sunshine. The wire was vicible with difficulty to one observer at 150 feet and beyond this disappeared utterly. To the others it could be fairly made out only at 100 feet. The thread, which was much brighter than the wire, began to be lost in parts at 200 feet, but in sunshine held rather indistinctly but unmistakably to 300 feet. When the sun went in the thread was lost at about 200 feet. To summarize again

	Angular Diameter	Appearance
Wire	0''.86	Limit for all but one observer.
	0''.57	Fairly seen by one observer.
Thread	0''.92	Network distinct all over.
	0''.69	Parts distinct in sunshine.
	0''.55	Parts evident in sunshine.
	0''.46	Near limit of visibility. Only small bits of network seen.

In the case of the thread the brightness contrast between thread and background was about 16:1. With brilliant sunshine and a background of even deader black there might have been a slight further gain, but we were evidently close to the limit. It is rather noteworthy that there should be so near an agreement throughout as between dark on bright and bright on dark, but barring specular direct reflection the brightness contrast which determines visibility is not widely different in the two cases, and the *minimum visibile* for a linear object with strongly contrasted background would appear to be about 0''.5 ±. It is certainly less than 1/50 the *minimum visibile* for a round spot giving similar contrast, a remarkable evidence of the efficient coordination of retinal impressions.

Boston — Louis Bell

[4] *Bulletin Lowell Obs.*, No. 2.

[5] *Lowell Obs. Bull.* No. 10.

[6] *Pop. Ast.*, 23, 578.

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ENGINEERING SCIENCE BEFORE, DURING AND AFTER THE WAR[1]

THREE years of anxiety and stress have passed since the last meeting of the British Association. The weight of the struggle which pressed heavily upon us at the time of the Newcastle meeting in 1916 had increased so much in intensity by the spring of 1917 that the council, after consultation with the local committee at Bournemouth, finally decided to cancel the summer meeting of that year. This was the first time in the history of the association that an annual meeting was not held.

We all rejoice to feel that the terrible ordeal through which the whole empire has been passing has now reached its final phases, and that during the period of reorganization, social and industrial, it is possible to resume the annual meetings of the association under happier conditions. We have gladly and with much appreciation accepted the renewed invitation of our friends and colleagues at Bournemouth.

We are gathered together at a time when, after a great upheaval, the elemental conditions of organization of the world are still in flux, and we have to consider how to influence and mould the recrystallization of these elements into the best forms and most economic rearrangements for the benefit of civilization. That the British Association is capable of exerting a great influence in guiding the nation towards advancement in the sciences and arts in the most general sense there can be no ques-

[1] Address of the president of the British Association for the Advancement of Science, Bournemouth, 1919.

tion, and of this we may be assured by a study of its proceedings in conjunction with the history of contemporary progress. Although the British Association can not claim any paramount prerogative in this good work, yet it can certainly claim to provide a free arena for discussion where in the past new theories in science, new propositions for beneficial change, new suggestions for casting aside fetters to the advancement in science, art, and economics have first seen the light of publication and discussion.

For more than half a century it has pleaded strongly for the advancement of science and its application to the arts. In the yearly volume for 1855 will be found a report in which it is stated that:

> The objects for which the association was established have been carried out in three ways: First, by requisitioning and printing reports on the present state of different branches of science; secondly, by granting sums of money to small committees or individuals, to enable them to carry on new researches; and thirdly, by recommending the government to undertake expeditions of discovery, or to make grants of money for certain and national purposes, which were beyond the means of the association.

As a matter of fact it has, since its commencement, paid out of its own funds upwards of £80,000 in grants of this kind.

DEVELOPMENTS PRIOR TO THE WAR

It is twenty-nine years since an engineer, Sir Frederick Bramwell, occupied this chair and discoursed so charmingly on the great importance of the next-to-nothing, the importance of looking after little things which, in engineering, as in other walks of life, are often too lightly considered.

The advances in engineering during the last twenty years are too many and complex to allow of their description, however short, being included in one address, and, following the example of some of my predecessors in this chair, I shall refer only to some of the most important features of this wide subject. I feel that I can not do better than begin by quoting from a speech made recently by Lord Inchcape, when speaking on the question of the nationalization of coal: "It is no exaggeration to say that coal has been the maker of modern Britain, and that those who discovered and developed the methods of working it have done more to determine the bent of British activities and the form of British society than all the Parliaments of the past hundred and twenty years."

James Watt.—No excuse is necessary for entering upon this theme, because this year marks the hundredth anniversary of the death of James Watt, and in reviewing the past it appears that England has gained her present proud position by her early enterprise and by the success of the Watt steam-engine which enabled her to become the first country to develop her resources in coal, and led to the establishment of her great manufactures and her immense mercantile marine.

The laws of steam which James Watt discovered are simply these: That the latent heat is nearly constant for different pressures within the ranges used in steam-engines, and that, consequently, the greater the steam pressure and the greater the range of expansion, the greater will be the work obtained from a given amount of steam. Secondly, as may now seem to us obvious, that steam from its expansive force will rush into a vacuum. Having regard to the state of knowledge at the time, his conclusions appear to have been the result of close and patient reasoning by a mind endowed with extraordinary powers of insight into physical questions, and with the faculty of drawing sound practical conclusions from numerous experiments de-

vised to throw light on the subject under investigation. His resource, courage and devotion were extraordinary.

In commencing his investigations on the steam-engine he soon discovered that there was a tremendous loss in the Newcomen engine, which he thought might be remedied. This was the loss caused by condensation of the steam on the cold metal walls of the cylinder. He first commenced by lining the walls with wood, a material of low thermal conductivity. Though this improved matters, he was not satisfied; his intuition probably told him that there should be some better solution of the problem, and doubtless he made many experiments before he realized that the true solution lay in a condenser separate from the cylinder of the engine. It is easy after discovery to say, "How obvious and how simple," but many of us here know how difficult is any step of advance when shrouded by unknown surroundings, and we can well appreciate the courage and the amount of investigation necessary before James Watt thought himself justified in trying the separate condenser. But to us now, and to the youngest student who knows the laws of steam as formulated by Carnot, Joule and Kelvin, the separate condenser is the obvious means of constructing an economical condensing engine.

Watts experiments led him to a clear view of the great importance of securing as much expansion as possible in his engines. The materials and appliances for boiler and machine construction were at that time so undeveloped that steam pressures were practically limited to a few pounds above atmospheric pressure. The cylinders and pistons of his engines were not constructed with the facility and accuracy to which we are now accustomed, and chiefly for these reasons expansion ratios of from twofold to threefold were the usual practise. Watt had given to the world an engine which consumed from five to seven pounds of coal per horse-power hour, or one-quarter of the fuel previously used by any engine. With this consumption of fuel its field under the conditions prevailing at the time was practically unlimited. What need was there, therefore, for commercial reasons, to endeavor still further to improve the engine at the risk of encountering fresh difficulties and greater commercial embarrassments? The course was rather for him and his partners to devote all their energy to extend the adoption of the engine as it stood, and this they did, and to the Watt engine, consuming from five to seven pounds of coal per horse-power, mankind owes the greatest permanent advances in material welfare recorded in history.

With secondary modifications, it was the prime mover in most general use for eighty years, *i. e.* until the middle of last century. It remained for others to carry the expansion of steam still further in the compound, triple, and, lastly, in the quadruple expansion engine, which is the most economical reciprocating engine of to-day.

Watt had considered the practicability of the turbine. He writes to his partner, Boulton, in 1784: "The whole success of the machine depends on the possibility of prodigious velocities. In short, without God makes it possible for things to move them one thousand feet per second, it can not do us much harm." The advance in tools of precision, and a clearer knowledge of the dynamics of rotating bodies, have now made the speeds mentioned by Watt feasible, and, indeed, common, everyday practise.

Turbines. The turbine of to-day carries the expansion of steam much further than has been found possible in any reciprocating engine, and owing to this property it

has surpassed it in the economy of coal, and it realizes to the fullest extent Watt's ideal of the expansion of steam from the boiler to the lowest vapor pressure obtainable in the condenser.

Among the minor improvements which in recent years have conduced to a higher efficiency in turbines are the more accurate curvature of the blades to avoid eddy losses in the steam, the raising of the peripheral velocities of the blades to nearly the velocity of the steam impinging upon them, and details of construction to reduce leakages to a minimum. In turbines of 20,000–30,000 h. p., 82 per cent. of the available energy in the steam is now obtainable as break-horse-power; and with a boiler efficiency of 85 per cent. the thermodynamic efficiency from the fuel to the electrical output of the alternator has reached 23 per cent., and shortly may reach 28 per cent., a result rivalling the efficiency of internal-combustion engines worked by producer-gas.

During the twenty years immediately preceding the war turbo-generators had increased in size from 500 kilowatts to 25,000 kilowatts, and the consumption of steam had fallen from 17 pound per kw.-hour to 10.3 pound per kw.-hour. Turbines have become the recognized means of generating electricity from steam on a large scale, although they have not superseded the Watt engine for pumping mines or the drawing of coal, except in so far as it is a means for generating electricity for these purposes. In the same period the engine-power in the mercantile marine had risen from 3,900 of the *King Edward* to 75,000 of the *Mauretania*.

As regards the Royal Navy, the engine-power of battleships prior to the war had increased from 12,000 i.h.p., to 30,000 s.h.p., while the speed advanced from 17 knots to 23 knots, and during the war, in ships of the *Queen Elizabeth* class, the power amounted to 75,000 s.h.p., with a speed of 25 knots. In cruisers similar advances were made. The i.h.p. of the *Powerful* was 25,000, while the s.h.p. of the *Queen Mary* was 78,000, with a speed of 28 knots. During the war the power obtained with geared turbines in the *Courageous* class was 100,000 s.h.p., with a speed of 32 knots, the maximum power transmitted through one gear-wheel being 25,000 h.p., and through one pinion 15,500 h.p.; while in destroyers speeds up to 39 knots have been obtained. The aggregate horse-power of war and mercantile turbined vessels throughout the world is now about 35,000,000.

These advances in power and speed have been made possible mainly by the successive increase in economy and diminution of weight derived from the replacement of reciprocating engines by turbines direct-coupled to the propellers, and later by the introduction of reduction gearing between the turbines and the propellers; also by the adoption of water-tube boilers and of oil-fuel. With these advances the names of Lord Fisher, Sir William White, and Sir Henry Oram will always be associated.

The Work of Sir William White.—With the great work of the Royal Navy fresh in our minds, we can not but recall the prominent part taken by the late Sir William White in its construction. His sudden death, when president-elect for 1913, lost to the nation and to the association the services of a great naval architect who possessed remarkable powers of prevision and dialectic. He was Chief Constructor to the Admiralty from 1885 to 1901, and largely to him was due the efficiency of our vessels in the great war.

White often referred to the work of Brunel as the designer of the *Great Eastern*, and spoke of him as the originator of the cellular construction of the bottoms of ships, since universally adopted, as a means of strengthening the hull and for ob-

taining additional safety in case of damage. Scott Russell was the builder of this great pioneer vessel, the forerunner of the Atlantic liners, and the British Association may rightly feel satisfaction in having aided him when a young man by pecuniary grants to develop his researches into the design and construction of ships and the wave-line form of hull which he originated, a form of special importance in paddle-wheel vessels.

So much discussion has taken place in the last four years as to the best construction of ship to resist torpedo attacks that it is interesting to recall briefly at the present time what was said by White in his Cantor lectures to the Royal Society of Arts in 1906:

> Great attention has been bestowed upon means of defence against underwater torpedo attacks. From the first introduction of torpedoes it was recognized that extreme watertight subdivision in the interior of warships would be the most important means of defence. Experiments have been made with triple watertight skins forming double cellular sides, the compartments nearest the outer bottom being filled, in some cases, with water, coal, cellulose, or other materials. Armor-plating has been used both on the outer bottom and on inner skins.

He also alludes to several Russian ships which were torpedoed by the Japanese, and he concludes by saying:

> "Up to date the balance of opinion has favored minute watertight subdivisions and comparatively thin water-tight compartments, rather than the use of internal armor, the use of which, of course, involves large expenditure of weight and cost."

The present war has most amply confirmed his views and conclusions, then so lucidly and concisely expressed.

While on the subject of steamships, it may perhaps be opportune to say one word as to their further development. The size of ships had been steadily increasing up to the time of the war, resulting in a reduction of power required to propel them per ton of displacement. On the other hand, thanks to their greater size and more economical machinery, speeds have been increased when the traffic has justified the greater cost. The limiting factor to further increase in size is the depth of water in the harbors. With this restriction removed there is no obstacle to building ships up to 1,000 feet in length or more, provided the volume and character of the traffic are such as to justify the capital outlay.

Tungsten Steel.—Among other important pre-war developments that have had a direct bearing upon the war, mention should be made of the discovery and extensive use of alloys of steel. The wonderful properties conferred upon steel by the addition of tungsten were discovered by Muschet in 1868, who has not been sufficiently credited with his share in making the Bessemer process a practical success, and later this alloy was investigated and improved by Maunsel White and Taylor, of Philadelphia. The later showed that the addition of tungsten to steel has the following effect: That after the steel has been quenched at a very high temperature near its melting point, it can be raised to a much higher temperature than is possible with ordinary carbon tool-steel without losing its hardness and power of cutting metal. In other words, it holds the carbon more tenaciously in the hardened state, and hence tungsten-steel tools, even when red-hot, can cut ordinary mild steel. It has revolutionized the design of machine tools, and has increased the output on heavy munition work by 100 per cent., and in ordinary engineering by 50 per cent.

The alloys of steel and manganese with which Sir Robert Hadfield's name is associated have proved of utility in immensely increasing the durability of railway and tramway points and crossings, and for the hard teeth of machinery for the crushing of stone and other materials, and, in fact, for

any purposes where great hardness and strength are essential.

Investigation of Gaseous Explosions.—Brief reference must also be made—and it will be gratifying to do so—to the important work of one of the committees of the British Association appointed in 1908, under the chairmanship of the late Sir William Preece, for the investigation of gaseous explosions, with special reference to temperature. The investigations of the committee are contained in seven yearly reports up to 1914. Of the very important work of the committee I wish to refer to one investigation in particular, which has proved to be a guiding star to the designers and manufacturers of internal-combustion engines in this country. The members of the committee more directly associated with this particular investigation were Sir Dugald Clerk, Professor Callendar, and the late Professor Bertram Hopkinson.

The investigation showed that the intensity of the heat radiated by the incandescent gases to the walls of the cylinder of a gas-engine increases with the size of the cylinder, the actual rate of this increase being approximately proportional to the square root of the depth of the radiating incandescent gas; the intensity was also shown to increase rapidly with the richness of the gas. It suffices now to say that the heat in a large cylinder with a rich explosive mixture is so intense that the metal eventually cracks. The investigation shows why this occurs, and by doing so has saved enormous sums to the makers of gas- and oil-engines in this country, and has led them to avoid the large cylinder, so common in Germany before the war, in favor of a multiplicity of smaller cylinders.

Charles A. Parsons

(To be continued)

A QUESTION CONCERNING THE NATURE OF VELOCITY

Tolman's remarkable success in deriving by means of his principle of similitude[1] a large number of physical laws, laws which have also been otherwise derived by the more natural and usual method of experimentation and measurement, ought to indicate that there is probably something fundamentally right about his method of procedure. His argument involves two universes, while physics knows only one—and the bearing of his conclusions upon the single universe that we know is not altogether apparent. When he further asks it to be assumed that the velocity of light and the charge of the electron shall be the same in both universes, his argument seems far removed from the facts of the laboratory and its relevance to the usual physics may be, and indeed has been, brought into serious question.

But his argument may be developed without any appeal to two universes. So developed it has an important bearing upon the theories of the nature of electricity and of the manner of the propagation of light. Consider any two observers in our present universe, each of whom with a different set of standards of measurement makes experiments and determines laws. The laws determined by the two observers will have the same algebraic form and will differ only in the value of the constants which they involve. Since all of the measureable quantities of physics are defined in terms of three fundamental and ultimately undefined quantities, each observer will need only three standards[2] in order that he may

[1] Tolman, *Phys. Rev.*, 3, 244, 1914; 4, 145, 1914; 6, 219, 1915; 8, 8, 1916; 9, 237, 1917. Buckingham, *ibid.*, 4, 345, 1914. Nordstrom, *Finska Vetenskaps Soc. Forh.*, 57, 1914–15; Afd. A. No. 22. Ishiwara, *Science Report of Tokoku Imp. Univ.*, 5, 33, 1916. Ehrenfest-Afanassjewa, *Phys. Rev.*, 8, 1, 1916. Bridgman, *ibid.*, 8, 423, 1916. Karrer, *ibid.*, 9, 290, 1917.

[2] All seem agreed that length and time are fundamental and undefinable. About the third quantity, force or mass, or energy, as the case may be, there seems to be considerable debate. The argument of the present paper is valid, whichever one of them is favored. I have chosen *force* be-

measure all quantities which come within his observation. The standards of the two observers, O and O', may be connected by algebraic equations, for length, $l' = x\,l$, for time $t' = yt$, and for force, $f' = zf$, where x, y and z are constants which may have any value and which express the ratio between the magnitudes of the corresponding standards of the two observers. From these three equations corresponding "transformation equations," involving x, y and z, for all of the measureable quantities of physics may be calculated. Suppose now that the two observers got together and O says to O':

> **Surely it is the privilege of each of us to work with whatever standards he prefers, you prefer foot-seconds while I prefer gram-centimeters; yet let us, for such and such reasons and for our mutual convenience, each still keeping his standards different from those of the other, so alter our standards that we can both report all electrical charges and all velocities by precisely the same numerical value.**

O' may be conceived to reply:

> **We know indeed that electrical charges are made up of a number of ultimate charges or electrons and that each of these little charges has the same magnitude. If we report all charges by the same number, that is virtually the same as each of us reporting the same count. I see that in favor of your suggestion, but I know of no corresponding consideration in regard to velocity. I see that there is only one really correct way of reporting the magnitude of charges. But I do not see that such is the case for velocities.**

Suppose however, that O and O' do put the agreement into effect. Then $v' = v$, and $e' = e$.

Then

$$v' = \frac{l'}{t'} = \frac{xl}{yt} = \frac{x}{y}(v) = v; \quad \text{and} \quad x = y.$$

Also

$$e' = \sqrt{f'l'^2} = \sqrt{zfx^2l^2} = x\sqrt{z}\cdot\sqrt{fl^2} = x\sqrt{z}\cdot e = e; \quad \text{and} \quad z = \frac{1}{x^2}.$$

Transformation equations involving only one unknown quantity, x, may now be written connecting all of the measurable quantities of O with the corresponding quantities of O'. These equations are identical with those of Tolman; and O and O', working with the perfectly legitimate[3] mathematical reasoning that Tolman uses, may derive, by virtue of their simple agreement, all of the conclusions which he derives from his principle of similitude.

So long as O and O' have no agreement between themselves, the transformation equations connecting their various quantities will involve three unknown quantities, x y and z.

cause it seems to me to be primary in the course of experience, not because it makes any difference in the general argument. Many physicists, perhaps most, are disposed to believe that there are two additional fundamental and ultimately undefined quantities necessary to complete the structure of modern physics, namely, (1) temperature or entropy (for thermodynamics) and (2) quantity of electricity or magnetic permeability (for electromagnetics). But temperature is defined by the gas-law, and charge is defined by Coulomb's law. These laws, discovered by the experimentation of workers in whose minds temperatures and charges (respectively) were regarded as equal if in similar situations they produced equal effects, have gradually come in the history of science to assume the sacred functions reserved for definitions. It can not be asserted too strongly that they are *not* "*laws.*" This, however, is methodology, not theoretical physics, and not the central argument of the present paper.

[3] To illustrate the method of reasoning—The transformation equation for energy density is

$$u' = \frac{1}{x^4}u,$$

and that for temperature,

$$T' = \frac{1}{x}T.$$

If energy density is a function solely of temperature, then $u = F(T)$ and $u' = F(T')$ where F in both equations has precisely the same value, for both observers obviously will find the same law. Substituting in the equation $u' = F(T')$, we have

$$\frac{1}{x^4}u = F\left(\frac{1}{x}T\right).$$

But $u = F(T)$, hence

$$\frac{1}{x^4}F(T) = F\left(\frac{1}{x}T\right).$$

The only solution of this functional equation is $F(a) = ka^4$. Hence $u = kT^4$, and Stefan's law has been demonstrated without experiment.

Only when the number of these unknown quantities is reduced to one, does it become possible for them to make use of the mathematical reasoning, involving the solution of functional equations, which has led in the hands of Tolman to such a wide variety of useful results. Since x is the ratio between their standards of length-measurement, and y that between their standards of time-measurement, they can express y in terms of x if they agree to make the same numerical report about any one kind of quantity which involves both length and time for its definition, that is, if they agree to make the same reports either about velocities or about accelerations. By making a corresponding second agreement about some quantity which involves for its definition force *and* time *or* length *or both*, such for instance as charge or mass or energy, they will be able to express z in terms of x—and to derive an entire set of transformation equations which involve only one unknown quantity. With this new set of equations at hand, they may undertake to set up functional expressions and to derive laws as Tolman has done.

Evidently the number of the different possible sets of transformation equations is quite considerable, for there are many measurable quantities in physics which involve for their definition more than one of the three fundamental undefined quantities. I have calculated nine such different sets. Several of them lead to *some* of the conclusions which may be deduced from the equations of O and O' above (based upon agreements concerning velocities and charges); several of them lead, in cases where the set of O and O' has proved fertile, to insoluble or absurd functional equations which point to no solution. Some of them lead to laws which are contrary to those whose validity has been established by experiment. None of the sets is as fertile or leads to as many well established laws as the set which is based upon the agreement of O and O' to report all charges and all velocities by the same numerical value. But this agreement is the only thing in the way of an *assumption* which is involved in the simplified form of Tolman's principle of similitude that is developed by O and O' of this paper. The noteworthy success of Tolman in deriving from his principle a large number of experimentally valid laws is evidence that an agreement between observers working with different standards of measurement to report the same charges and velocities by the same number is somehow more intimately in harmony with the order of nature than any other similar agreement relative to some other of the quantities of physics.

Electrical charges may be regarded as if they are made up of a countable number of small units. This has been adequately demonstrated by the researches of Millikan and others in which electrons have actually been isolated and counted. But it could also have been predicted—for, as an assumption, it leads in the hands of O and O' to many conclusions which are otherwise verified by experimental fact. In the same way the assumption that velocities are of such sort that there is only one right way to report their magnitude, is one which leads, vastly better than any similar assumption, to the deduction of laws which are established in fact. Hence the assumption is probably true.

Professor Tolman has kindly read the first draft of this paper. He suggests that the conclusion that velocity is of such nature that there is only one right way to report its magnitude, a conclusion which has here been reached by abstract reasoning, may be interpreted concretely to mean that "any given velocity is most sensibly regarded as a given fraction of the maximum possible velocity, namely that of light."

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JACQUES DANNE

WITH the outbreak of the world conflict in 1914 *Le Radium* at once ceased publication, all of its editors being called into service. The decision for service was no less definite than the assurance that publication would be

resumed with the coming of peace. Little did any one think that the renewal of publication would be in the hands of other than Jacques Danne. Indeed, the war being finally over Danne himself was busy with the preparation of the first new number when a sudden and rapid illness culminated in his death on March 8, leaving the science of radio-activity and electronics sadly weakened.

Jacques Danne was born in Paris in 1882. After excellent schooling he entered the Ecole de Physique et Chemie de Paris in 1897, where he distinguished himself as the first in a remarkable class of scientific students. He was invited by Curie to become his assistant in 1902, and at once added the power of his knowledge to Curie's work. Curie, working entirely as a physicist, had met innumerable problems which were leading up to the disintegration theory. The chaotic condition of the science of radioactivity in the years 1898–1902 was due chiefly to the fact that it was carried on by physicists without aid of chemical methods. These latter Soddy supplied in Montreal and Danne in Paris, and within a year the fact of atomic disintegration was established, and radio-activity became a science.

In 1904 M. Danne founded *Le Radium*, the first number of which appeared on July 15. He gathered about him an impressive "scientific committee" to insure an adequate treatment of all phases of the sciences of radioactivity and electronics, radiation and ionization; in short, of subatomic phenomena. For ten years he gave the greater part of his time to this journal, and in 1914 it was the sole representative of this very vital field of knowledge.

Six numbers of Volume 11 appeared in 1914, and now Number 7, Volume 11, appears in May, 1919, under the direction of Gaston Danne, the younger brother of Jacques, who for many years has been the chief spirit in the admirable Laboratoire d'Essais des Substances Radioactives, which Danne established at Gif in the Vallée de la Chevreuse.

The loss of Jacques Danne is irreparable, but under the direction of M. Gaston Danne *Le Radium* will continue admirably to serve the new science of subatomic phenomena. At the request of M. Danne I am receiving papers and subscriptions at this address.

GERALD L. WENDT
UNIVERSITY OF CHICAGO

SCIENTIFIC EVENTS

EXPEDITIONS FROM THE UNIVERSITY OF CALIFORNIA

JUST returning from a four month's expedition through southeastern Alaska and northern British Columbia, a party of scientific men under the leadership of Dr. Joseph Grinnell from the University of California has brought about 1,200 specimens of birds and mammals representing nearly all of the birds and smaller species of mammals inhabiting the country, as well as a few examples of the larger mammals, such as mountain goat, grizzly bear, wolf and beaver. Some amphibians, plants, and a large number of photographs also were brought back.

H. S. Swarth, curator of birds, and Joseph Dixon, economic mammalogist, assisted at times by local guides and hunters, comprised a party which started from Wrangell, Alaska, and went to Telegraph Creek, British Columbia, a distance of 170 miles from the coast and at the head of navigation on the Stikine River, traveling by the river boat which runs on the stream during the five months of the year when it is free of ice. On the return trip down stream camps were established at various points and explorations were pursued.

Reports from the party indicate that the coast of southeastern Alaska is characterized by extremely heavy rainfall while the interior toward the source of the Stikine River is relatively arid.

The country about the upper Stikine River for a long time has been a mecca for big game hunters, this region being one of the few remaining places in North America where a variety of such game may be pursued with a fair assurance of success. But this year's expedition of the Museum of Vertebrate Zoology of the University of California is said to be the first party of naturalists to visit and care-

fully study the smaller animal life along certain routes of the Stikine River region. Extensive collections are said to have been made at points heretofore not visited by any naturalist.

It is planned later to publish a report based on this material with the field notes written during the summer months. Such a publication will be in the nature of a continuation of other reports based on previous explorations of the museum some years ago covering investigation of the animal life of the northwest coast of North America. Previous trips have covered much of the mainland and most of the islands off the coast of southeastern Alaska.

Miss Annie M. Alexander, founder of the Museum of Vertebrate Zoology of the University of California, made possible this year's work as well as past years' investigations.

JOINT MEETING OF THE AMERICAN PHYSICAL SOCIETY WITH THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

A JOINT meeting of the American Physical Society and the American Institute of Electrical Engineers, arranged by the Committee on Technical Physics, will be held in Philadelphia, at the Bellevue-Stratford Hotel, on Friday and Saturday, October 10 and 11, 1919.

The Technical sessions on Friday will be held in the Clover Room of the Bellevue-Stratford and the subscription dinner Friday evening in the Stratford Room. The technical sessions on Saturday will be held at the works of the Leeds and Northrup Company, where a complimentary luncheon will be served by the company.

The program is as follows:

FRIDAY, 9:00 A.M.

Session of the Physical Society

Atomic structure, papers by P. W. Bridgeman, of Harvard University, and by Irving Langmuir, of the Research Laboratory of the General Electric Company. There will be a formal discussion by Saul Dushman and others.

FRIDAY, 2:30 P.M.

Session of the A. I. E. E.

1. *The arrangement of atoms in metals*, by A. W. Hull, of the General Electric Research Laboratory. An X-ray study of crystal structures, illustrated with models of crystals.
2. *The oscillating vacuum tube as a generator of electrical power*, by J. H. Morecroft and H. T. Friis, both of Columbia University. Lantern slides of oscillograph records.
3. *Electromagnetic induction*, by J. S. Barnett, of the Department of Terrestrial Magnetism, Carnegie Institution.
4. *Piezo-electrical effect*, by A. M. Nichols, of the Western Electric Company. (Demonstration.)

FRIDAY, 6:00 P.M.

Subscription Dinner

Five minute talks by the presidents of the two societies.

FRIDAY, 8:00 P.M.

Technical papers by H. A. Bumstead, of Yale University, and J. J. Carty, Vice-president of the American Telephone and Telegraph Company.

SATURDAY MORNING

Session of the Physical Society

Inspection of the Leeds and Northrup laboratories.

Several semi-technical papers will be presented by the physicists of the Research Laboratories of the Leeds and Northrup Company.

SATURDAY NOON

Complimentary luncheon by the Leeds and Northrup Company.

Automobile ride around Germantown.

SATURDAY AFTERNOON

A regular session of the Physical Society will be held on Saturday afternoon in the auditorium of the Leeds and Northrup Company, for the reading of miscellaneous papers. Members wishing to present papers should send abstracts, *ready for publication*, to the secretary at once. Probably the program for this session will not be ready for distribution in advance of the meeting.

There will probably be opportunity for technical excursions to the Welsbach factory or a steamer ride on the Delaware River to Chester at 10:30 Friday morning. The steamer ride will be available Saturday morning also.

Other meetings of the American Physical Society will be held in Chicago on November 28 and 29, and in St. Louis in the week of December 29 to January 3. Members are urged

to submit abstracts of papers well in advance of the date of the meeting at which they are to be presented.

DAYTON C. MILLER,
Secretary

CASE SCHOOL OF APPLIED SCIENCE,
CLEVELAND, OHIO

THE RED CROSS AND PROFESSOR RICHARD P. STRONG

DR. RICHARD P. STRONG, professor of tropical medicine at the Harvard Medical School, sailed on October 2 for Europe, where he is to be general medical director of the League of Red Cross Societies, with headquarters in Geneva. He has been granted leave of absence for a year by Harvard University.

The league is a new international association of the Red Cross planned to act as a central agency for the improvement of public health, the prevention of disease and the mitigation of suffering throughout the world. It will also serve in cases of national or international disaster. Another of its purposes is to promote the welfare of mankind by furnishing a medium for bringing within the reach of all the peoples the benefits to be derived from present known facts, new contributions and medical knowledge and their application.

Henry P. Davison is chairman of the board of governors of the league, and the director-general of the league is Lieutenant-General Sir David Henderson, of Great Britain. The public health work and general medical activities of the league will be under the direction of Dr. Strong. In this position he will be the executive at Geneva responsible for stimulating the medical work of the various Red Cross societies and putting the latest medical information at the disposal of each of them. His office will be the general headquarters of the fight against epidemic diseases, such as that of influenza, which recently swept across the world, and particularly against the terrible typhus and other tropical epidemics.

Dr. Strong is fitted for this task by knowledge and experience. He went to the Harvard Medical School in 1913 with a distinguished record as a student of tropical diseases in the Philippine Islands, where he had begun as an army medical officer. In 1915 he was the leader of the international corps of workers who combatted the typhus epidemic in Serbia which had taken many thousands of lives.

After the United States entered the war in 1917, Dr. Strong was in charge of the Division of Infectious Diseases of the American Expeditionary Forces. He has received the Distinguished Service Medal of the American Expeditionary Forces, the British Order of Commander of the Bath, Officer of the French Legion of Honor and the Chinese Striped Tiger, and has been made Grand Officer of the Serbian Cross of St. Salva.

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held on November 10, 11 and 12, at Yale University, New Haven, Connecticut. Announcement of the arrangements for the meeting will be made later by the local committee.

DR. R. W. WOOD, professor of physics in the Johns Hopkins University, has been elected a foreign member of the Royal Society, London.

THE nomination of Mr. James R. Riggs, as assistant secretary of agriculture, has been confirmed by the Senate.

DR. D. G. BYERS, of the University of Washington, recently a captain in the Chemical Warfare Service in Washington, has been appointed chief of the division of chemistry of the Bureau of Soils.

MAJOR DOUGLAS JOHNSON, professor of physiography at Columbia University, has returned from Paris where he served as chief of the Division of Boundary Geography on the American Commission to Negotiate Peace, and as a member of different international territorial commissions.

RUSSELL L. CECIL, M.D., lately major, M. C., U. S. Army, William A. Perlzweig, Ph.D., lately lieutenant, Sanitary Corps, U. S. Army, and Mr. G. I. Steffen, lately lieutenant, Sanitary Corps, U. S. Army, have been engaged by the U. S. Public Health Service to carry out experimental investigations on influenza and pneumonia. The work will be conducted

in the research laboratories of the Department of Health of New York City under the direction of Dr. Cecil.

MAJOR R. G. HOSKINS, who has been for the past four months in charge of the Section of Food and Nutrition of the Surgeon-General's Office, has received his discharge from the service. He will spend the current academic year studying at the Johns Hopkins Medical School.

PROFESSOR F. K. RICHTMYER is on sabbatic leave for a year from Cornell, devoting a part of his time to research in the Research Laboratory of the General Electric Company, at Schenectady.

MR. JOSEPH MAILLIARD, honorary curator of ornithology, of the California Academy of Sciences, left San Francisco on September 15 with his assistant, Mr. Luther Little, to collect birds in Mendocino county, California. Mr. Mailliard secured a representative collection from this territory in June and now is covering the same ground to note seasonal changes and variations.

DR. J. A. LECLERC has resigned from the Bureau of Chemistry, U. S. Department of Agriculture, and is now with the Miner-Hillard Milling Company of Wilkes-Barre, Pennsylvania.

WE learn from the *Journal* of the American Medical Association that the University of Pisa recently organized a festal meeting to honor the fiftieth professional anniversary of Professor G. Romiti of the chair of anatomy. A marble portrait bust was unveiled, and Professor Romiti presented the university with his valuable library on anatomy

THE first lecture of the series of the Harvey Society will be given at the New York Academy of Medicine on October 18, by Lieutenant-Colonel George Dreyer, M.D., professor of general pathology, Oxford University, on "Biological Standards and their Application to Medicine." The second lecture of the series will be given on October 25 by Dr. H. H. Dale, of the Lister Institute of Preventive Medicine, London, on "Shock."

DR. AUGUST HOCH, who was for seven years the director of the Psychiatric Institute on Ward's Island, died on September 23, in San Francisco.

A LEGACY of $60,000 has been made by the late Dr. Rizzi, physician in chief of the Ospedale Maggiore at Milan, to found an institute for the research and practise of biochemistry.

THE legislature of Alabama has passed the Alabama Mental Deficiency bill which appropriates $200,000 for the establishment of the Alabama Home for Mental Inferiors at Tuscaloosa in connection with the Bryce Hospital. As a part of the campaign for securing the passage of this measure, Dr. W. D. Partlow, superintendent of the Alabama Insane Hospitals, and Dr. Thomas H. Haines, field agent for the National Committee for Mental Hygiene, made a careful mental survey of the four industrial schools of the state last May. This was a cooperative piece of work of the Alabama State Board of Health and the National Committee for Mental Hygiene. One hundred and twenty-nine of the six hundred and fifty-four juvenile delinquents in the schools were found to be so defective in mental ability as to demand institution care of a custodial sort for their proper management. These facts proved a potent argument in securing the appropriation.

THE Fédération française des sociétés de sciences naturelles has been formed consisting of thirteen society units: les Sociétés Zoologique, Entomologique, d'Acclimatation, de Pisciculture; l'Association des Anatomistes; les Société de Botanique, de Mycologie, de Pathologie végétale; la Société philomatique; la Société géologique; la Société des Naturalistes parisiens; la Société de Chimie biologique. It is proposed to establish five categories for the purpose of bibliographic documentation: (1) botany; (2) anatomy and embryology; (3) zoology; (4) general biology, and (5) physiology.

UNIVERSITY AND EDUCATIONAL NEWS

A NEW mechanical engineering building and a new physics building are nearing completion

at the Agricultural and Mechanical College of Texas. The Texas Legislature has recently provided $250,000 for an agricultural building also. Plans and specifications are now being drawn for this building which will be started next summer.

THE Georgia Legislature, at its recent session, increased its appropriation for the medical department of the State University from $30,000 to $55,000. Of the new funds, the sum of $20,000 is to be used to establish a course in Public Health and Hygiene, and the sum of $5,000 is to be added to the general income of the school.

IN the medical department of the University of Pennsylvania Dr. William H. F. Addison has been made a full professor of histology and embryology; Dr. Oscar H. Plant has been promoted to a full professorship in pharmacology; Dr. Byron M. Hendricks and Raymond Stehle have been promoted to assistant professorships of physiologic chemistry.

DR. HERBERT S. LANGFELD has been appointed director of the psychological laboratory of Harvard University and Dr. L. T. Troland and Dr. Floyd H. Allport, have been appointed instructors in psychology. Dr. William McDougall, whose appointment as professor of psychology was reported in a recent issue of SCIENCE, will take up his work at the beginning of the next academic year.

THE department of botany of Kansas State Agricultural College has been reorganized and is now carrying on its work in the college and experiment station under the name of the department of botany and plant pathology. L. E. Melchers, for two years acting head of the department, has been made professor of plant pathology and head of the department. E. C. Miller, formerly associate professor, has been promoted to be professor of plant physiology. The other members of the department are Assistant Professors W. E. Davis and F. C. Gates, Instructors H. H. Haymaker and Nora E. Dalbey, and Assistant Dorothy Cashen.

THE new chair of physical education at the Agricultural and Mechanical College of Texas has been filled by Dr. W. J. Young, who held the rank of captain in the National Army during the war. Previously he was director of physical education in the University of Maine. Professor D. Scoates has been appointed head of the department of agricultural engineering to succeed Professor R. A. Andree, who has resigned.

GEORGE P. BACON, of Simmons College, has been appointed to succeed Dr. H. H. Marvin, of Tufts College, who is going to the University of Nebraska, as head of the department of physics. Professor Bacon is to be chairman of the department of physics at Tufts College.

DR. R. E. LOVING, head of the department of physics in Richmond College, has been granted leave of absence for the current session, which he will spend doing special work in Cornell University. C. H. Willis, late of the Signal Corps, A. E. F., and V. E. Ayre, from the Bureau of Standards, have recently been appointed, respectively, acting professor and asistant professor in the department.

LIEUTENANT HORACE A. HOLADAY, Sanitary Corps, nutrition officer at the port of embarkation at New Port News, Va., formerly assistant professor of chemistry at the University of Idaho, has been appointed professor of physiological chemistry and head of the division of food and physiological chemistry at North Dakota Agricultural College.

RALPH J. GILMORE, Ph.D. (Cornell), of Huron College, has been appointed head of the department of biology of Colorado College, succeeding Dr. E. C. Schneider, who becomes head of the department of biology at Connecticut Wesleyan College.

DR. JOHN L. SHELDON, who has had charge of the work in botany and bacteriology in the West Virginia University for the past sixteen years, has resigned. The university has also lost recently the heads of the departments of animal husbandry, agronomy, horticulture, public speaking and philosophy.

DR. J. G. FITZGERALD, associate professor of hygiene, University of Toronto, and director of the Connaught Antitoxin Laboratories in the

same institution, has been appointed professor of hygiene, succeeding Dr. John A. Amyot, who has been appointed deputy minister of health in the Federal Department of Health, Ottawa. Dr. Fitzgerald will continue to act as director of the Connaught Laboratories.

PROFESSOR L. BARD, who for twenty years has held the chair of clinical medicine at the University of Geneva, has accepted a corresponding position at the University of Strasburg.

DISCUSSION AND CORRESPONDENCE

EMIL FISCHER AFTER THE WAR

THE reading of Professor Harrow's highly appreciative account, in SCIENCE of August 15, of Emil Fischer and his work recalls to me a meeting that I had with Fischer in February of this year in Berlin. I have referred, in a recent little book[1] about Germany and Germans since the war, to a conversation which Dr. Alonzo E. Taylor and I, officially representing Mr. Hoover and the American Food Administration, had in our rooms in the Hotel Adlon in Berlin one Sunday morning last February with three distinguished German scientific men. The conversation was primarily an interview with these well-informed men on the subject of the German food situation; we were there to try to find out just what food importations were immediately necessary to keep the German people from further suffering and danger. We had talked with responsible officials of the new German government, and been presented with various official statements by them, but we wanted to check these by any unofficial information we could obtain. Hence this Sunday morning meeting in our hotel rooms with Karl Ballod, Germany's foremost economic statistician, Nathan Zuntz, one of her first animal physiologists, and Emil Fischer, her great organic chemist. But as scientific and university men our talk ran rather freely and frankly, and touched other matters than food statistics.

It was a conversation of fascinating interest, with Fischer the dominant figure in it. Ballod, tall and spare, of serious mien, was rather restrained and precise; Zuntz, small and active, even smiling, was perhaps a little exaggeratedly gracious; Fischer, heavy-bodied, vigorous and emphatic, was easy and with no trace of self-consciousness. All agreed on the terrible seriousness of the situation but each had special views as to the more pressing necessities and means of meeting them. All declared that they had realized for more than a year the practical certainty of Germany's ultimate collapse, but replying to our questions as to why they had not used their knowledge of the fatal food and general economic situation to prevail on the German authorities to try to end the war while an ending might be made that would be less disastrous than any that could come after a further persistence in the struggle, all declared their complete helplessness to exercise a sufficient influence on rulers or people. "We should not have been heard at first and before we could push the matter to a general hearing we should have been in prison or have had to flee the country to avoid it. Remember Forster and Nicolai and Muehlon," they said.

They told of their own difficulties to find food for themselves and families, despite their sufficient financial means, and then spoke especially of the terrible hardships of their less well paid colleagues and small-salaried assistants. Fischer, in particular, revealed his sympathy for his distressed helpers, while all three spoke of the serious handicap the situation had been on the work in the scientific institutions with which they were affiliated.

But while Ballod looked on the future darkly, and Zuntz with no confidence, Fischer was more sanguine. He said: "We have got to start again, but we *can* start." When we told him that both America and England had made some headway during the war period in the production of dyes and optical glass and some other things that had been a monopoly of Germany in the days before the war, and that we should be far more independent in such ways than we had been before, Fischer was silent a moment, thoughtful and serious of face, but soon looked up and said: "Well, that

[1] "Germany in the War and After," 1919, Macmillan Co., N. Y.

sounds rather bad; but"—and he smiled confidently and made a large gesture with his open hands—"we'll make something new that you'll have to have." It was a fine confidence, and characteristic of the wonder-worker who had all his life been making "something new."

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL,
WASHINGTON

THE AURORAL DISPLAY OF SEPTEMBER 18

ON the evening of September 18, shortly after eleven o'clock and continuing until after twelve, there was the most unusual manifestation of aurora borealis at Fargo that we have ever witnessed. It consisted of an intensely luminous band some five degrees in width, extending through the zenith from one horizon to the other. The eastern end was some fifteen degrees south of east and the western end a corresponding distance north of west. The band was very uniform in width and intensity, though somewhat wider and more intense at the zenith. It had the general appearance of an intense shaft of light from a powerful searchlight, except for its direction and position. At the same time there was a considerable manifestation of aurora at the north, but between that and the band spoken of there was no illumination.

We have never had our attention called to a like phenomenon and we are wondering if it was observed at other points.

C. B. WALDRON

AURORAL DISPLAYS AND THE MAGNETIC NEEDLE

IN connection with the auroral displays of August 11 last, mentioned in these columns on August 22, it may be of interest to mention the behavior of the magnetic needle at Omaha at the time. The wire chief of the Western Union Telegraph Company called me by telephone that morning and said that there was very considerable and unusual trouble with earth currents over the wires between Chicago and Cheyenne as far south as Kansas City. Upon this notification I began to observe the behavior of the magnetic needle. I have two fine needles about 4 inches long, one in a transit with a full circle, and the other in a plane table with a range of only 5 degrees on either side of the zero. As the first trembled too much on account of the mechanical vibrations of the floor of the room, I confined my attention to the second. I saw the north end of the needle first creep a few degrees to the west, and then by slow stages advance as far as five degrees to the east. Although I kept myself as motionless as possible, I saw the needle swing violently to the west, the full range of the case, through an arc, therefore, of more than 10 degrees, so that it rebounded by its impact against the side. This was at about 5 P.M., Summer Central Time.

A double track electric railway ran north and south about 150 feet to the east of the needle. At almost its nearest point there is a break in both trolley lines, serving as a division point between two sections. This meant that the current supplied over the trolley to the cars was suddenly interrupted whenever the cars came to this division point. I watched the needle very closely at these moments to see whether this feature might account for its oscillations, but could not find the least connection. The next day the needle was as quiet as if it had been riveted to its case.

WILLIAM F. RIGGE

QUOTATIONS

SCIENCE AND THE PRESS

Is it possible for the newspaper press to be a useful intermediary between the investigator and the public? Mr. Chester H. Rowell, a well-known American journalist, discussed the question at the recent Pacific meeting of the American Association for the Advancement of Science. Neither here nor in the United States can there be any doubt as to the advantage of widespread knowledge of the methods, the objects, the results, and the personalities of science. Even during the war we suffered much from misapprehension of these. Science was called on to produce, and did produce, magical results as a conjuror produces rabbits from his sleeve. There was no appreciation of the long training, the elaborate

apparatus, and the skilled methods required for these feats. And too often the specifications of the inventions were amended by ignorant officials, and their application entrusted to unskilled persons. Such costly errors can be avoided in the future, and the requisite support given to the deliberate pursuit of science, only if the nation generally learns to understand and sympathize with scientific men and scientific work.

Mr. Rowell is confident that the popular press is indispensable for any general contact with a wide public. He offers advice, based on American conditions, as to how such a result may be accomplished. He distinguishes between the daily newspapers and the Sunday newspapers. The latter vehicle is less sharply marked off in this country than in America, Germany and Vienna, where the vast bulk of the Sunday issues overwhelms those who make first acquaintance with them. Mr. Rowell says that it is necessary to "print an excessive amount of reading matter, to float the advertising." The news will not go round, and so, as a desperate resort, the editors have recourse to literature, science, and the arts. Scientific men are given this friendly advice: the Sunday papers will take anything, even science. But entrance to the columns of the daily newspapers is another matter. That goes by merit. The test of merit is that the "copy" is news. There is no hope, says this expert, of getting things printed as news because they are "useful or useless, beneficial or injurious." "The eternal verities are not news, though a temporary or adventitious fact regarding them may be." The reference, we repeat, is to conditions in the United States, but they may be worth noting by the English public, who are more responsible for the contents of the newspapers they read than they perhaps realize.—The London *Times*.

SCIENTIFIC BOOKS

Starfishes of the Philippine Seas and Adjacent Waters. By WALTER K. FISHER. United States National Museum Bulletin 100. Washington, Government Printing Office. 1919. Pp. xxi + 712, 156 pls.

For several years, students of echinoderms have been awaiting with some impatience the appearance of Fisher's complete report on the sea-stars collected by the *Albatross* in the East Indian region, between December, 1907, and December, 1910. Several preliminary papers have appeared, in which most of the novelties were described, but it was well understood that the full report would be a monograph of the greatest importance to the morphologist and zoogeographer as well as to the systematist.

This expectation is wholly justified by the present volume, with its wealth of illustration and its ample discussions of structural and taxonomic problems. The brief preface, besides the customary acknowledgments for help received, recounts the chief facts as to number of species collected, the number of novelties and the new genera and subgenera represented. An introduction of some twenty pages gives a brief historical sketch of our knowledge of Philippine sea-stars and then plunges into a detailed analysis of the distribution of the species and the relationships of the fauna. There is a very large amount of zoogeographical material presented here, but the obvious criticism may be made that the treatment is too exclusively analytical. Probably, in view of the fact that the large and highly important material collected by the *Siboga* in the Dutch East Indies is as yet but partially studied, Dr. Fisher felt that any conclusions drawn from the *Albatross* material alone would be premature and almost certainly liable to revision. The introduction closes with two pages of analysis of the composition of the *Albatross* collection and one wonders why this is placed at this point rather than in connection with the similar data presented in the preface. Following the introduction is an important list of the sea-stars of Celebes and the Moluccas, with the authority given for each record, and then is given the list of *Albatross* stations at which sea-stars were taken.

Examination of this station list reveals some interesting facts. The largest number of species taken at any one station was *nine*

and that occurred but once. This was at station 5648 in Buton Strait, Celebes, in water 559 fathoms deep, and it is very remarkable that all of the nine species were new to science, three represented new genera, and of only one was there more than a single specimen! Surely this is one of the most notable dredgings of sea-stars ever made. At two of the *Albatross* stations, *seven* species of sea-stars were taken, but these were both in shallow water (9 or 10 fathoms) in the Tawi Tawi group; in one case, all were representatives of previously known species; in the other there were two new species, one representing a remarkable new genus. At each of two stations in the Philippines, 5482 at 67 fathoms and 5536 at 279 fathoms, half a dozen species were taken.

The remainder of the volume is occupied with the detailed account of 182 species and 10 subspecies, all but two of which were taken by the *Albatross*. Only one or two are here described for the first time, but 134 were new when taken and were originally described from this collection. Many of these are notable for structural peculiarities and 18 represented new genera, while others made the segregation of 6 additional genera or subgenera desirable. The method of treatment is admirable; a brief diagnosis of each species is followed by a description, more or less detailed according to the condition of the material and the importance of the species. If young specimens are available, a special paragraph is given to them, the features in which they differ from the adult being pointed out. The museum number of the holotype and the exact position of the type-locality are then given, followed by a statement of the known distribution and a list of the specimens examined. Last, and oftentimes most important of all, is a paragraph of "Remarks," in which is discussed the relationships of the form, its diversities and peculiarities, and any nomenclatural or distributional facts that need elucidation.

Many of the families and genera are treated in the same thoroughgoing way and in these discussions, Dr. Fisher's exceptional knowledge of sea-stars and of the literature concerning them is well shown. But more than this is revealed—clear thinking, openmindedness and a perfectly balanced judgment, that are very attractive and most convincing. The writer has no hobbies to ride and no hypotheses to defend; he is obviously seeking all the available facts and only the deductions which may reasonably be drawn from them. He is always seeking to throw light on the subject in hand and to unsnarl the tangles due to lack of knowledge or to misinformation. The frequent and carefully detailed keys to species and genera well illustrate this and will prove of constant service to other workers.

The recognition of subspecies, in the ornithological sense of forms passing by gradation into the typical form but occupying a different geographical area, is something of a novelty in the taxonomy of echinoderms but is of course the natural result of increasing knowledge. The question which may fairly be raised is whether we have sufficient data and material as yet to warrant their recognition. Probably we have in some cases, but in others it were well to be cautious. Thus Fisher recognizes the typical form and three subspecies (using trinomials as in ornithology) of *Asterina coronata*, of which very few specimens are as yet known; it is quite possible that we are here dealing with a somewhat variable species, and a large amount of material will show that there is no correlation between the diversities and the distribution.

In typography, arrangement and illustration the volume is very satisfactory. It is too bad that "starfishes" is used in the title when Dr. Fisher is known to be an advocate of "sea-stars" as a substitute for the more familiar word. No doubt the editor considered "starfishes" a more "popular" title but it is so lamentably inaccurate, it is a pity Fisher could not have had his way in the matter. It is a little odd that neither term seems to be used in the text; at any rate, I have found neither; but once the phrase is used, "specimens of Asteroidea"! There is a good table of contents at the beginning of the volume, and at its end, a very full and useful index. The plates are half-tones, printed on both sides of the paper, interleaved

with pages of explanatory text; the arrangement is unusual and at first sight not attractive, but as soon as one has become accustomed to it, it is found to have much to commend it. The photographs from which most of the plates were made are exceptionally clear and hence the necessity of using halftones is not so unfortunate as might be. The impossibility of using a lens on such plates is counterbalanced by the numerous drawings of the essential details, so that every important species is amply illustrated. The volume is a credit to the Government Printing Office, as well as to the National Museum, and it amply confirms Fisher's position as chief among students of the Asteroidea.

Hubert Lyman Clark

NOTES ON METEOROLOGY AND CLIMATOLOGY

AGRICULTURAL METEOROLOGY

Since weather is a prime factor in crop production, the study of agricultural meteorology is not lagging in this great farming country. It is only comparatively recently, however, that the U. S. Department of Agriculture has made available a large amount of reliable information about crops in such a form as to be used readily for comparison with weather and climate. For six years there has been a division of agricultural geography, Mr. O. E. Baker in charge, the principal object of which has been to issue by sections a carefully wrought "Atlas of American Agriculture." An advance rainfall map of the United States,[1] and advance folios on Frost and the Growing Season,[2] and on Cotton[3] have appeared, as well as extensive graphic contributions in the Year Book of the U. S. Department of Agriculture, 1915,[4] 1916,[5] 1917[6] and 1918,[7] and a fine small atlas on "The Geography of the World's Agriculture."[8] The Weather Bureau's contribution to the Atlas of American Agriculture has been the material for the climatic section, of which there is much still to be published; and now its division of agricultural meteorology, Professor J. Warren Smith, in charge, is pushing forward several lines of investigation on the influence of weather and climate on dates of planting and harvesting crops and on crop yields,[9] and on the occurrence of damaging frosts and the possibility of forecasting them from weather conditions the day before.[10] Furthermore, with the excellent crop maps now available, Professor R. DeC. Ward, of Harvard, has written an interesting interpretation of the "Larger relations of climate and crops in the United States." Some of the recent Weather Bureau contributions to agricultural meteorology will be reviewed briefly here.

Relation between Vegetative and Frostless Periods (by J. B. Kincer, *Mo. Weather Rev.*, Feb., 1919, Vol. 47, pp. 106–110, 5 figs., 8 charts). Since 6° C. (about 43° F.) is gen-

1 Reproduced in *Mo. Weather Rev.*, July, 1917, and discussed on pp. 338–345 by R. DeC. Ward. (Reviewed in Science, N. S., Vol. 48, July 19, 1918, pp. 67–71.)

2 Reviewed in *Mo. Weather Rev.*, November, 1918, pp. 516–517, and in *Geog. Rev.*, May, 1919, pp. 339–344. (Reprinted, *Sci. Am. Suppl.*, August 23, 1919, pp 117–118.)

3 The climatology of the cotton plant is being reprinted in the *Mo. Weather Rev.*, July, 1919, and is reviewed in *Geog. Rev.*, May, 1919, pp. 348–349.

4 "A Graphic Summary of American Agriculture," by Middleton Smith, O. E. Baker and R. G. Hainsworth, pp. 329–403, 4 graphs, 78 maps.

5 "A Graphic Summary of World Agriculture," by V. C. Finch, O. E. Baker and R. G. Hainsworth, pp. 531–553, 74 figs.

6 "A Graphic Summary of Seasonal Work on Farm Crops," by O. E. Baker, C. F. Brooks and R. G. Hainsworth, pp. 537–589, 90 figs. Abstracted and discussed in *Mo. Weather Rev.*, May, 1919, pp. 323–327.

7 "Arable Land in the United States," by O. E. Baker and H. M. Strong, Separate 771, 10 pp., 10 graphs, 9 maps.

8 By V. C. Finch and O. E. Baker (Office of Farm Management, U. S. Dept. of Agric.) Washington, 1917. Reviewed in *Jour. of Geog.*, January, 1919, pp. 39–40.

9 A thorough discussion of the effect of weather on the yields of corn, potatoes and winter wheat, by J. Warren Smith, is published in Proc. Second Pan-Am. Sci. Cong., 1915–16, Vol. 2, pp. 75–92: see review, in *Geog. Rev.*, Vol. 4, 1917, p. 317.

10 "Predicting Minimum Temperatures," by J. Warren Smith, *Monthly Weather Review*, August, 1917, pp 402–407.

erally considered as the temperature at which most plant growth begins in spring and ends in fall, Mr. Kincer made maps showing the advance and retreat of the isotherm of 43° F. in the United States in spring and fall and of the length of the period between the date in spring when the normal mean daily temperature rises above 43° F. in spring and falls below it in autumn. This period he called the "vegetative period." These maps were then compared with the corresponding maps of last killing frost in spring, first killing frost in autumn and average length of the growing season (*i. e.*, between killing frosts); and other maps were made to show the differences, which amount to about ten days in the North and thirty or more in the South, the vegetative period being the longer. Other maps show that the normal mean daily temperature on the average frost dates just mentioned are for most of the country between 50° and 57° F.; on the Great Lakes, the Pacific, and the Atlantic north of Hatteras, however, the corresponding temperatures are below 50° F. Mr. Kincer points out that protective measures against frost damage may be well worth while in the South, where the vegetative period usually continues for weeks after the first killing frost, but not in the North, where, in autumn for example, low temperatures would soon stop the growth of vegetation which might have been protected from the first killing frost.

Temperature Influence on Planting and Harvest dates (by J. B. Kincer, *Mo. Weather Review*, May, 1919, Vol. 47, pp. 312–323, 20 figs., inclu. maps).—This is based largely on a study of the maps in "A Graphic Summary of Seasonal Work on Farm Crops,"[6] in comparison with temperature data.

It is suggested that the mean temperature at which planting of a given crop can be accomplished be used as a base, or starting point, for any method that may be employed for temperature summation, instead of a general base for all crops (*e. g.*, 6° C.). . . . Spring wheat seeding usually begins . . . when the normal daily temperature rises to 37° or 40° F. The corresponding temperature for spring oats is 43°, for early potatoes, 45°, for corn 55° and for cotton 62° F. Cotton and corn are warm-weather crops and the areas in which successful production on a commercial scale can be accomplished are limited principally by both the general temperature conditions and the temperature at which planting may be accomplished. There is a close relation between spring temperatures and the condition of these crops to certain dates in the early stages of growth.

Alfalfa Hay and Seed Growing in South Dakota and Utah (separate papers by H. N. Johnson of Rapid City, S. Dak., and J. C. Alter of Salt Lake City, *Mo. Weather Rev.*, May, 1919, Vol. 47, pp. 328–332, 5 figs.).—"Alfalfa seed is usually produced [in S. Dak.] when conditions are such as to retard the maturing of the first hay crop, and then in paying quantities only when there is a comparative shortage in the moisture supply, hence the weather conditions determine whether the second crop shall be cut for hay or left for seed. If there is considerable rainfall, the second crop is usually cut for hay, and a third crop is frequently possible." As rainfall conditions fluctuate widely on the Great Plains, the western South Dakota alfalfa farmer has in such an arrangement a fine insurance against drought or unusual amounts of rainfall. In Utah the seed-crop, which follows a cutting for hay, needs special weather conditions for the best yields: there should be

sufficient moisture during its early growth to produce a vigorous, healthy plant, but the weather should be dry and not too warm while the plants are in bloom. The dry spell must not be too extended, however, as the seed must have sufficient moisture while setting to give it size and weight. It takes nearly twice as long to grow and mature a seed crop as it does a hay crop. As the seed crop is not always ripe on the occasion of the first killing frost in fall, considerable importance is attached to frost and minimum temperature forecasts. On the receipt of frost warnings, the usual practise is to cut as large an area as possible; but as the first cold period is often followed by several weeks of fine ripening weather, and as the value of the seed is said to increase at the rate of nearly \$5 an acre each 24 hours when ripening, efforts should be made to protect the plants from frost damage without cutting.

CHARLES F. BROOKS

WASHINGTON, D. C.

SPECIAL ARTICLES

WHITE CORN VS. YELLOW CORN AND A PROBABLE RELATION BETWEEN THE FAT-SOLUBLE VITAMINE AND YELLOW PLANT PIGMENTS

As the importance of the vitamines in the physiological economy of the animal is coming to be appreciated, observations on their occurrence and their distribution in nature are being rapidly accumulated in various laboratories. As is to be expected, with data on vitamine distribution available, there is a growing inclination to deduce therefrom, not only evidence as to their possible rôle in living organisms, but also a suitable working hypothesis enabling one to predict in an unknown whether the amount of vitamine is liable to be large or small. Furthermore, from the viewpoint of the chemist, it scarcely needs to be emphasized what a step in advance it would be if from their occurrence in nature an idea could be obtained as to their possible chemical character.

We are still far distant from this goal in the case of the anti-scorbutic and anti-neuritic vitamines, but in the case of the fat-soluble vitamine, the mere fact—as its name indicates—that it is soluble in fats and also its solubility in many fat solvents excludes from consideration many compounds.

Two years ago the writer experienced some difficulty in getting rats to rear their young on a ration which, to a considerable extent, consisted of corn. Failure was often indicated by an inflammation of the eyes—a xerophthalmia, which Osborne and Mendel[1] first indicated as evidence of a deficiency of the fat-soluble vitamine. No further attention was paid to this difficulty beyond modifying the ration to increase its content of this dietary essential. Later, however, rats were again put on a similar ration and no difficulty was experienced. With many other apparent inconsistencies arising in a colony of a thousand animals, and all of them bearing investigation no immediate attention was given to this matter.

During the course of the past year a considerable amount of work dealing with the occurrence of the fat-soluble vitamine in roots was completed. It was indicated that, while the colored roots such as carrots and sweet potatoes are rich in this dietary essential, sugar beets, mangels, dasheens and Irish potatoes contain little or none of it. It was then recalled that at the time that the difficulty with female rats to rear their young had been observed, it had been impossible to obtain sound yellow corn on the local market and white corn had been used instead. This had been done in a part of the stock colony and as the conditions for its maintenance are fairly well standardized and not always under close personal supervision the relation between the slight modification in the ration and the disastrous results had not been detected.

It has now been conclusively demonstrated with eight different varieties of corn which are extensively grown in the middle west, that while white corn contains no demonstrable amounts of the fat-soluble vitamine, yellow corn may contain sufficient amounts to allow normal growth and reproduction in the rat. One rat has successfully reared her young after having been fed yellow corn suitably supplemented with vitamine-free protein and salts for seven months. On white corn, similarly supplemented, young rats usually die in three months with the typical symptoms of a fat-soluble vitamine deficiency.

These relations suggested the possibility of correlating other instances of the simultaneous occurrence of the fat-soluble vitamine and yellow plant pigments. We have at hand the interesting observation of Osborne and Mendel[2] that while the oleo oils contain the vitamine, the solid beef fats do not. They state specifically that the oleo oils were yellow while the solid fats were colorless. Furthermore, they were also able to separate the butter fats by fractional crystallization into an active fraction of the liquid fats—which was yellow—and an inactive fraction—which was colorless.

[1] T. B. Osborne and L. B. Mendel, *Jour. Biol. Chem.*, 16, 431, 1913.

[2] T. B. Osborne and L. B. Mendel, *Jour. Biol. Chem.*, 20, 379, 1915.

In an investigation of the nutritive properties of commercial oleos and their ingredients, the writer and coworkers[3] have found a considerable difference in their vitamine content. It is significant that of the oleo oils those most highly pigmented were also the richest in fat-soluble vitamine and those least pigmented were the poorest. This, in view of the present prevailing conception of the importance of the vitamine content of certain fats in the diet, is a matter of such great economic significance that comment on it is reserved until the investigations now in progress shall have been completed. It is mentioned here merely to indicate why it is considered possible that the fat-soluble vitamine may be one of the yellow pigments or a closely related compound.

In scores of feeding experiments in which butter fat as prepared from ordinary butter has been used as the source of the fat-soluble vitamine we have repeatedly observed variations in the vitamine content. It has not been possible to correlate this with the degree of pigmentation—which is well known to vary with the feed and the breed of the dairy cow—as the amount of natural pigment present had been concealed by the addition of butter color. One fact however appears particularly significant, and that is, that when butter fat is heated its vitamine is destroyed and simultaneously there occurs a destruction of its pigment.[3] Whether this is an accidental coincidence or one and the same thing remains to be seen.

From the evidence submitted it appears reasonably safe, at least as a working hypothesis, to assume that the fat-soluble vitamine is a yellow plant pigment or a closely related compound, which view, moreover, is strengthened by the fact that we know through the work of Palmer and Eckles[4] of the inability of the animal to synthesize the yellow pigments carotin and xanthophyll. From its occurrence in butter, in leaves, in carrots and in other materials known to be rich in carotin, it might be concluded that we were here concerned with carotin. Some data, that we have accumulated have answered this in the negative and it has been so reported,[5] but it appears doubtful if much importance can be attached to these earlier results as we have since observed that carotin under certain conditions is a very labile compound. We do not desire to mislead our readers by indicating that we have conclusive evidence one way or another.

Provisionally, we are assuming that the fat-soluble vitamine is one of the yellow plant pigments, but we are not unmindful of the possibility that the reasons for the association of these properties in nature, viz., yellow pigmentation and this growth-promoting property may be a genetic one in some cases, while in others it may be indicative of mere similarity in physical if not chemical properties. If it is not a pigment, no doubt, instances will soon be found where it is found to occur liberally in non-pigmented materials. We already have indications that certain materials are as rich in the fat-soluble vitamine as is yellow corn, yet they are far less pigmented. Whether this can be explained in difference of kind of pigment which in yellow corn is known to be principally xanthophyll or whether we are dealing in these instances with the leuco compound remains to be seen.

It is scarcely necessary to elaborate on these findings or to point out their possible economic significance. Many investigations based on the general premises which we have here outlined are now in progress and will be reported as the evidence obtained seems to warrant a detailed discussion.

H. Steenbock

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[3] H. Steenbock, P. W. Boutwell and Hazel E. Kent, *Jour. Biol. Chem.*, 35, 517, 1918.

[4] L. S. Palmer and C. H. Eckles, *Jour. Biol. Chem.*, 17, 211, 223, 237, 245, 1914.

[5] H. Steenbock, P. W. Boutwell and Hazel E. Kent, *Proc. Amer. Soc. Biol. Chem.*, 1919.

THE AMERICAN MATHEMATICAL SOCIETY

The twenty-sixth summer meeting of the society was held at the University of Michigan, September 2–4, in conjunction with meetings of the Mathematical Association of America and the

American Astronomical Society. On Thursday afternoon there was a joint session, at which the following papers were presented:

"Mathematics and statistics," retiring address of the president of the Mathematical Association of America, by E. V. HUNTINGTON.

"The work of the National Research Council with reference to mathematics and astronomy," by E. W. BROWN.

Reports on the international conference of scientists at Brussels, by FRANK SCHLESINGER and L. A. BAUER.

The following papers were presented to the society:

On wind corrections: PETER FIELD.

Cauchy's memoir of 1814 on definite integrals: H. J. ETTLINGER.

Expansion of any determinant in minors from rectangular panels: L. H. RICE.

Pseudo-canonical forms and invariants of systems of partial differential equations: A. L. NELSON.

On the separation of complex roots of an algebraic equation: A. J. KEMPNER.

Some theorems on the zeros of solutions of homogeneous linear differential equations of the nth order: C. N. REYNOLDS, JR.

Some theorems on the zeros of solutions of self-adjoint homogeneous linear differential equations of the fifth order: C. N. REYNOLDS, JR.

Proof of the existence of distinct three-dimensional manifolds with the same group: J. W. ALEXANDER.

Certain determinants expressible as circulants or skew-circulants: E. D. ROE, JR.

A brief account of the life and work of the late Professor Ulisse Dini: W. B. FORD.

The resolvents of König and other types of symmetric functions: S. P. SHUGERT.

Form of the number of subgroups of prime-power groups: G. A. MILLER.

A generalization of a formula of Schubert in enumerative geometry: E. S. ALLEN.

Joint axis congruences with indeterminate developables: E. P. LANE.

A modification of an integral test for the convergence and divergence of infinite series: R. W. BRINK.

Certain types of involutorial space transformations (second paper): F. R. SHARPE and VIRGIL SNYDER.

Transformations of surfaces applicable to a quadric: L. P. EISENHART.

Transformations of cyclic systems of circles: L. P. EISENHART.

Differential equations containing arbitrary functions: G. A. BLISS.

Functions of lines in ballistics: G. A. BLISS.

On the relative positions of the complex roots of an algebraic equation with real coefficients and those of its derived equation: D. R. CURTISS.

Urn schemata as a basis for the development of the theory of correlation: H. L. RIETZ.

Projective transformations in function space (second paper): L. L. DINES.

On the invariants belonging to a hypernumber in an algebra of infinite order: J. B. SHAW.

Conditions necessary and sufficient for the existence of a Stieltjes integral: R. D. CARMICHAEL.

Note on convergence tests for series and on Stieltjes integration by parts: R. D. CARMICHAEL.

Note on a physical interpretation of Stieltjes integrals: R. D. CARMICHAEL.

An apparent anomaly in errors of interpolated values: H. A. HOWE.

Transformations of a Stieltjes integral potential: G. C. EVANS.

Note on sequences of Stieltjes integrals: T. H. HILDEBRANDT.

Differential equations of motion of a projectile regarded as a particle: W. H. ROEVER.

Certain properties of binomial coefficients: W. D. CAIRNS.

On the shape of polynomial curves: A. J. KEMPNER.

Abstracts of these papers and a fuller report of the meeting will be published in the November number of the *Bulletin of the American Mathematical Society.*

E. J. MOULTON,
Acting Secretary

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ENGINEERING SCIENCE BEFORE, DURING AND AFTER THE WAR. II

IN coming to this section of my address I am reminded that in the course of his presidential address to section G, in 1858, Lord Rosse said:

> Another object of the Mechanical Section of the association has been effected—the importance of engineering science in the service of the state has been brought more prominently forward. There seems, however, something still wanting. Science may yet do more for the Navy and Army if more called upon.

Comparatively recently too, Lord French remarked:

> We have failed during the past to read accurately the lessons as regards the fighting of the future which modern science and invention should have taught us.

In view of the eminent services which men of science have rendered during the war, I think that we may be justified in regarding the requirement stated by Lord Rosse as having at last been satisfied, and also in believing that such a criticism as Lord French rightly uttered will not be levelled against the country in the future.

Though British men of science had not formerly been adequately recognized in relation to war and the safety of their country, yet at the call of the sailors and the soldiers they whole-heartedly, and with intense zeal, devoted themselves to repair the negligence of the past, and to apply their unrivalled powers and skill to encounter and overcome the long-standing machinations of the enemy. They worked in close collaboration with the men of science of the allied nations, and eventually produced better war material, chem-

icals, and apparatus of all kinds for vanquishing the enemy and the saving of our own men than had been devised by the enemy during many years of preparation planned on the basis of a total disregard of treaties and the conventions of war.

Four years is too short a time for much scientific invention to blossom to useful maturity, even under the forced exigencies of war and government control. It must be remembered that in the past the great majority of new discoveries and inventions of merit have taken many years—sometimes generations—to bring them into general use. It must also be mentioned that in some instances discoveries and inventions are attributable to the general advance in science and the arts which has brought within the region of practical politics an attack on some particular problem. So the work of the men of science during the war has perforce been directed more to the application of known principles, trade knowledge and properties of matter to the waging of war than to the making of new and laborious discoveries; though, in effecting such applications, inventions of a high order have been achieved some of which promise to be of great usefulness in time of peace.

The advance of science and the arts in the last century had, however, wrought a great change in the implements of war. The steam-engine, the internal-combustion engine, electricity, and the advances in metallurgy and chemistry had led to the building up of immense industries which, when diverted from their normal uses, have produced unprecedented quantities of war material for the purposes of the enormous armies, and also for the greatest navy which the world has ever seen.

The destructive energy in the field and afloat has multiplied many hundredfold since the time of the Napoleonic wars; both before and during the war the size of guns and the efficiency of explosives and shell increased immensely, and many new implements of destruction were added. Modern science and engineering enabled armies unprecedented in size, efficiency and equipment to be drawn from all parts of the world and to be concentrated rapidly in the fighting line.

To build up the stupendous fighting organization, ships have been taken from their normal trade routes, locomotives and material from the home railways, the normal manufactures of the country have been largely diverted to munitions of war; the home railways, tramways, roads, buildings and constructions, and material of all kinds have been allowed to depreciate. The amount of depreciation in roads and railways alone has been estimated at £400,000,000 per annum at present prices. Upon the community at home a very great and abnormal strain has been thrown, notwithstanding the increased output per head of the workers derived from modern methods and improved machinery. In short, we have seen for the first time in history nearly the whole populations of the principal contending nations enlisted in intense personal and collective effort in the contest, resulting in unprecedented loss of life and destruction of capital.

A few figures will assist us to realize the great difference between this war and all preceding wars. At Waterloo, in 1815, 9,044 artillery rounds were fired, having a total weight of 37.3 tons, while on one day during the last offensive in France, on the British front alone, 943,837 artillery rounds were fired, weighing 18,080 tons—more than 100 times the number of rounds, and nearly 540 times the weight of projectiles. Again, in the whole of the South African War 273,000 artillery rounds were fired, weighing approximately

2,800 tons; while during the whole war in France, on the British front alone, more than 170,000,000 artillery rounds were fired, weighing nearly 3,500,000 tons—622 times the number of rounds, and about 1,250 times the weight of projectiles.

However great these figures in connection with modern land artillery may be, they become almost insignificant when compared with those in respect of a modern naval battle squadron. The *Queen Elizabeth* when firing all her guns discharges 18 tons of metal and develops 1,870,000 foot-tons of energy. She is capable of repeating this discharge once every minute, and when doing so develops by her guns an average of 127,000 effective h.p., or more than one and one half times the power of her propelling machinery; and this energy is five times greater than the maximum average energy developed on the western front by British guns. Furthermore, if all her guns were fired simultaneously, they would for the instant be developing energy at the rate of 13,132,000 h.p. From these figures we can form some conception of the vast destructive energy developed in a modern naval battle.

With regard to the many important engineering developments made during the war, several papers by authorities are announced in the syllabus of papers constituting the sectional proceedings of this year's meeting. Among them are "Tanks," by Sir Eustace d'Eyncourt; "Scientific Progress of Aviation during the War," by L. Bairstow; "Airships," by Lieutenant-Colonel Cave-Brown-Cave; "Directional Wireless, with Special Reference to Aircraft," by Captain Robinson; "Wireless in Aircraft," by Major Erskine Murray; "Wireless Telegraphy during the First Three Years of the War," by Major Vincent Smith; "Submarine Mining," by Commander Gwynne; "Emergency Bridge Construction," by Professor Ingles; and "The Paravane," by Commander Burney. Accordingly, it is quite unnecessary here to particularize further except in the few following instances:

Sound-ranging and Listening Devices.—Probably the most interesting development during the war has been the extensive application of sound-listening devices for detecting and localizing the enemy. The Indian hunter puts his ear to the ground to listen for the sound of the footsteps of his enemy. So in modern warfare science has placed in the hands of the sailor and soldier elaborate instruments to aid the ear in the detection of noises transmitted through earth, water, air or ether, and also in some cases to record these sounds graphically or photographically, so that their character and the time of their occurrence may be tabulated.

The sound-ranging apparatus developed by Professor Bragg and his son, by which the position of an enemy gun can be determined from electrically recorded times at which the sound-wave from the gun passes over a number of receiving stations, has enabled our artillery to concentrate their fire on the enemy's guns, and often to destroy them.

The French began experimenting in September, 1914, with methods of locating enemy guns by sound. The English section began work in October, 1915, adopting the French methods in the first instance. By the end of 1916 the whole front was covered, and sound-ranging began to play an important part in the location of enemy batteries. During 1917 locations by sound-ranging reached about 30,000 for the whole army, this number being greater than that given by any other means of location. A single good set of observations could be relied upon to give the position of an enemy gun to about 50 yards at 7,000

yards' range. It could also be carried on during considerable artillery activity.

The apparatus for localizing noises transmitted through the ground has been much used for the detection of enemy mining and counter-mining operations. Acoustic tubes, microphones and amplifying valves have been employed to increase the volume of very faint noises.

For many years before the war the Bell Submarine Signalling Co., of which Sir William White was one of the early directors, used submerged microphones for detecting sound transmitted through the water, and a submerged bell for sending signals to distances up to one mile. With this apparatus passing ships could be heard at a distance of nearly a mile when the sea was calm and the listening vessel stationary.

Of all the physical disturbances emitted or produced by a moving submarine, those most easily detected, and at the greatest distance, are the pressure-waves set up in the water by vibrations produced by the vessel and her machinery. A great variety of instruments have been devised during the war for detecting these noises, depending on microphones and magnetophones of exceedingly high sensitivity. Among them may be particularly mentioned the hydrophones devised by Captain Ryan and Professor Bragg, being adaptations of the telephone transmitter to work in water instead of air. These instruments, when mounted so as to rotate, are directional, being insensitive to sound-waves the front of which is perpendicular to the plane of the diaphragm, and giving the loudest sound when the diaphragm is parallel to the wave-front.

Another preferable method for determining direction is to use two hydrophones coupled to two receivers, one held to each ear. This is called the biaural method, and enables the listener to recognize the direction from which the sound emanates.

When the vessel is in motion or the sea is rough, the water noises from the dragging of the instrument through the water and from the waves striking the ship drown the noises from the enemy vessel, and under such conditions the instruments are useless. The assistance of eminent biologists was of invaluable help at this juncture. Experiments were made with sea-lions by Sir Richard Paget, who found that they have directional hearing under water up to speeds of six knots. Also Professor Keith explained the construction of the hearing organs of the whale, the ear proper being a capillary tube, too small to be capable of performing any useful function in transmitting sound to the relatively large aural organs, which are deep set in the head. The whale therefore hears by means of the sound-waves transmitted through the substance of the head. It was further seen that the organs of hearing of the whale to some degree resembled the hydrophone.

The course now became clear. Hollow towing bodies in the form of fish or porpoises were made of celluloid, varnished canvas, or very thin metal, and the hydrophone suitably fixed in the center of the head. The body is filled with water, and the cable towing the fish contains the insulated leads to the observer on board the vessel. When towed at some distance behind the chasing ship disturbing noises are small, and enemy noises can be heard up to speeds of fourteen knots, and at considerable distances. Thermionic amplifying valves have been extensively used, and have added much to the sensitiveness of the hydrophone in its many forms.

After the loss of the *Titanic* by collision with an iceberg, Lewis Richardson was granted two patents in 1912 for the de-

tection of above-water objects by their echo in the air, and under-water objects by the echo transmitted through the water. The principles governing the production and the concentration of beams of sound are described in the specification, and he recommends frequencies ranging from 4,786 to 100,000 complete vibrations per second, and also suggests that the rate of approach or recession from the object may be determined from the difference in the pitch of the echo from the pitch of the blast sent out. Sir Hiram Maxim also suggested similar apparatus a little later.

The echo method of detection was not, however, practically developed until French and English men of science, with whom was associated Professor Langevin, of the Collège de France, realizing its importance for submarine detection, brought the apparatus to a high degree of perfection and utility shortly before the armistice. Now with beams of high-frequency sound-waves it is possible to sweep the seas for the detection of any submerged object, such as icebergs, submarines, surface vessels, and rocks; they may also be used to make soundings. It enables a chasing ship to pick up and close in on a submarine situated more than a mile away.

The successful development of sound-ranging apparatus on land led to the suggestion by Professor Bragg that a modified form could be used to locate under-water explosions. It has been found that the shock of an explosion can be detected hundreds of miles from its source by means of a submerged hydrophone, and that the time of the arrival of the sound-wave can be recorded with great precision. At the end of the war the sound-ranging stations were being used for the detection of positions at sea required for strategical purposes. The same stations are now being used extensively for the determination of such positions at sea as light-vessels, buoys which indicate channels, and obstructions such as sunken ships. By this means ships steaming in fog can be given their positions with accuracy for ranges up to 500 miles.

Among the many other important technical systems and devices brought out during the war which will find useful application under peace conditions as aids to navigation I may mention directional wireless, by which ships and aircraft can be given their positions and directed, and on this subject we are to have a paper in Section G.

Leader-gear, first used by the Germans to direct their ships through their mine fields, and afterwards used by the Allies, consists of an insulated cable laid on the bottom of the sea, earthed at the farther end, through which an alternating current is passed. By means of delicate devices installed on a ship, she is able to follow the cable at any speed with as much precision as a railless electric 'bus can follow its trolley-wire. Cables up to fifty miles long have been used, and this device promises to be invaluable to ships navigating narrow and tortuous channels and entering or leaving harbors in a fog.

Aircraft.—It may be justly said that the development in aircraft design and manufacture is one of the astonishing engineering feats of the war. In August, 1914, the British Air Services possessed a total of 272 machines, whereas in October, 1918, just prior to the armistice, the Royal Air Force possessed more than 22,000 effective machines. During the first twelve months of the war the average monthly delivery of aeroplanes to our Flying Service was 50, while during the last twelve months of the war the average deliveries were 2,700 per month. So far as aero-engines are

concerned, our position in 1914 was by no means satisfactory. We depended for a large proportion of our supplies on other countries. In the Aerial Derby of 1913, of the eleven machines that started, not one had a British engine. By the end of the war, however, British aero-engines had gained the foremost place in design and manufacture, and were well up to requirements as regards supply. The total horse-power produced in the last twelve months of the war approximated to eight millions of brake horse-power, a figure quite comparable with the total horse-power of the marine-engine output of the country.[2]

Much might be written on the progress in aircraft, but the subject will be treated at length in the sectional papers. In view of the recent trans-Atlantic flight, however, I feel that it may be opportune to make the following observations on the comparative utility of aeroplanes and airships for commercial purposes. In the case of the aeroplane, the weight per horse-power increases with the size, other things being equal. This increase, however, is met to some extent by a multiplicity of engines, though in the fuselage the increase remains.

On the other hand, with the airship the advantage increases with the size, as in all ships. The tractive effort per ton of displacement diminishes in inverse proportion to the dimensions, other things, including the speed, being the same. Thus an airship of 750 feet length and 60 tons displacement may require a tractive force of 5 per cent., or 3 tons, at 60 miles per hour; and one of 1,500 feet in length and $8 \times 60 = 480$ tons displacement would require only $2\frac{1}{2}$ per cent. $\times 480 = 12$ tons at the same speed, and would carry fuel for double the distance.

[2] See Lord Weir's paper read at the Victory meeting of the Northeast Coast Institution of Engineers and Shipbuilders, July, 1919.

With the same proportion of weight of hull to displacement, the larger airship would stand double the wind-pressure, and would weather storms of greater violence and hailstones of greater size. It would be more durable, the proportional upkeep would be less, and the proportional loss of gas considerably less. In other words, it would lose a less proportion of its buoyancy per day. It is a development in which success depends upon the project being well thought out and the job being thoroughly well done. The equipment of the airsheds with numerous electric haulage winches, and all other appliances to make egress and ingress to the sheds safe from danger and accident, must be ample and efficient.

The airship appears to have a great future for special commerce where time is a dominant factor and the demand is sufficient to justify a large airship. It has also a great field in the opening up of new countries where other means of communication are difficult. The only limitation to size will be the cost of the airship and its sheds, just as in steam vessels it is the cost of the vessels and the cost of deepening the harbors that limit the size of Atlantic liners.

Such developments generally take place slowly, otherwise failures occur—as in the case of the *Great Eastern*—and it may be many years before the airship is increased from the present maximum of 750 feet to 1,500 feet with success, but it will assuredly come. If, however, the development is subsidized or assisted by the government, incidental failures may be faced with equanimity and very rapid development accomplished.[3] In peace-time the seaplane, aeroplane and airship will most certainly have their uses. But, except for special services of high utility, it is ques-

[3] The literature on this subject includes an article which appeared in *Engineering* on January 3, 1919.

tionable whether they will play more than a minor part as compared with the steamship, railway and motor transport.

Electricity.—The supply and use of electricity has developed rapidly in recent years. For lighting it is the rival of gas, though each has its advantages. As a means of transmitting power over long distances it has no rival, and its efficiency is so high that, when generated on a large scale and distributed over large areas, it is a cheap and trustworthy source of power for working factories, tramways, suburban railways and innumerable other purposes, including metallurgical and chemical processes. It is rapidly superseding locally generated steam-power, and is a rival to the small- and moderate-sized gas and oil engines. It has made practicable the use of water-power through the generation of electricity in bulk at the natural falls, from which the power is transmitted to the consumers, sometimes at great distances.

Fifteen years ago electricity was generated chiefly by large reciprocating steam-engines, direct-coupled to dynamos or alternators, but of late years steam turbines have in most instances replaced them, and are now exclusively used in large generating stations because of their smaller cost and greater economy in fuel. The size of the turbines may vary from a few thousand horse-power up to about 50,000 h.p. At the end of last year the central electric stations in the United Kingdom contained plant aggregating 2,750,000 kilowatts, 79 per cent. of which was driven by steam turbines.

Much discussion has taken place as to the most economical size of generating stations, their number, the size of the generating units, and the size of the area to be supplied. On the one hand, a comparatively small number of very large or super-stations, instead of a large number of moderate-sized stations dotted over the area, results in a small decrease in the cost of production of the electricity, because in the super-stations larger and slightly more economical engines are employed, while the larger stations permit of higher organization and more elaborate labor-saving appliances. Further, if in the future the recovery of the by-products of coal should become a practical realization as part of the process in the manufacture of the electric current, the larger super-stations present greater facilities than the smaller stations. On the other, super-stations involve the transmission of the electricity over greater distances, and consequently greater capital expenditure and cost of maintenance of mains and transmission apparatus, and greater electrical transmission losses, while the larger generating unit takes longer to overhaul or repair, and consequently a larger percentage of spare plant is necessary.

The greatest element in reducing the cost of electricity is the provision of a good load factor; in other words, the utilization of the generating plant and mains to the greatest extent during the twenty-four hours of each day throughout the year. This is a far more important consideration than the size of the station, and it is secured to the best advantage in most cases by a widespread network of mains, supplying a diversity of consumers and users, each requiring current at different times of the day. The total load of each station being thus an average of the individual loads of a number of consumers is, in general, far less fluctuating than in the case of small generating and distributing systems, which supply principally one class of consumer—a state of affairs that exists in London, for instance, at the present time. It is true that there may be exceptional cases, such as at Kilmar-

nock, where a good load factor may be found in a small area, but in this case the consumers are chiefly mills, which require current for many hours daily.

There is no golden rule to secure cheap electricity. The most favorable size, locality and number of generating stations in each area can only be arrived at by a close study of the local conditions, but there is no doubt that, generally speaking, to secure cheap electricity a widespread network of mains is in most cases a very important, if not an essential, factor.

The electrification of tramways and suburban railways has been an undoubted success where the volume of traffic has justified a frequent service, and it has been remarkable that where suburban lines have been worked by frequent and fast electrical trains there has resulted a great growth of passenger traffic. The electrification of main-line railways would no doubt result in a saving of coal; at the same time, the economical success would largely depend on the broader question as to whether the volume of the traffic would suffice to pay the working expenses and provide a satisfactory return on the capital.

Municipal and company generating stations have been nearly doubled in capacity during the war to meet the demand from munition works, steel works, chemical works, and for many other purposes. The provision of this increased supply was an enormous help in the production of adequate munitions. At the commencement of the war there were few steel electric furnaces in the country; at the end of last year 117 were at work, producing 20,000 tons of steel per month, consisting chiefly of high-grade ferro alloys used in munitions.

Charles A. Parsons

(*To be concluded*)

PHYSIOLOGICAL ISOLATION BY LOW TEMPERATURE IN BRYOPHYLLUM AND OTHER PLANTS

In axiate plants a physiologically active growing tip inhibits more or less completely the development of other growing tips or axes of the same plant within a certain distance which varies to some extent with the intensity of physiological or metabolic activity in the inhibiting tip. This physiological correlation is not specific for the growing tips of stems and roots, but other parts of the plant, *e. g.*, leaves, may exert the same inhibiting effect to a greater or less degree. Removal of the growing tip or other inhibiting part, or a sufficient decrease in its metabolic activity abolishes its inhibiting action upon other parts. These facts have long been known, much experimental work has been done upon this problem of physiological correlation and various hypotheses have been advanced. As regards the manner in which such an effect of one part upon another at a greater or less distance may conceivably be produced, there are apparently three possibilities: first, the growing tip may inhibit indirectly by obtaining through its greater physiological activity the greater proportion of nutritive materials necessary for growth and development; second, the growing tip or other inhibiting part may produce substances which are transported by the fluids of the plant and which exert a specific inhibiting effect upon other parts; and third, the metabolic activity of the growing tip may produce dynamic changes which are conducted through the protoplasm of the plant and influence the physiological condition of the parts which they reach.

As regards the first of these possibilities it is difficult to conceive how in the bean seedling, to take a concrete case, the growing tip can so completely deprive the buds in the axils of the cotyledons of nutrition that they are unable to grow at all, although they are very much nearer the source of both inorganic and organic nutrition than the tip. The attempt to interpret this inhibition solely in nutritive terms has proven unsatisfactory.

The second possibility, the production of

more or less specific inhibiting substances, which are transported to other parts of the plant, also presents certain difficulties and inconsistencies. In the first place every growing tip must be immune to the inhibiting substances which it produces, yet these substances inhibit other growing tips; second, in the normal growth of most plants new growing tips of stems usually arise from previously existing growing tips: it is not their origin but their later development which is inhibited; third, the correlation exists in many simple plants, such for example as algæ, where there is, so far as we know, no mechanism for the transportation of such substances through the plant body; fourth, the inhibiting action is not a specific function of growing tips of stems for a leaf may inhibit a bud. In short when we attempt to interpret the facts in terms of inhibiting substances inconsistencies and contradictions began at once to appear.

The third possibility, that of a dynamic change of some sort, transmitted through the protoplasm, has been suggested by various authors, but the problem of the mechanism by which such a transmitted change produces an inhibiting effect has not been adequately considered.

Most experimental work along this line has consisted either in removing, or stopping or retarding the physiological activity of the inhibiting tip or other part, or in physical isolation of the inhibited part from its action. Another method of attack upon the problem which has been but little used consists in attempting to block the correlative factor somewhere along its path in the intact plant.[1] If it is possible to accomplish this blocking without injury to the plant and to make it temporary, *i. e.*, reversible, the nature of the conditions which bring about the block and the behavior of the parts of the plant on the two sides of the block may be expected to afford at least some basis for conclusions concerning the nature of the correlative factor which is blocked.

The experiments briefly described below were undertaken because it was believed that this method of temporarily blocking the correlative factor in its passage would prove particularly fruitful in plants and would afford a means of testing still further the general conception of physiological axiation which has been formulated by one of us on the basis of many different lines of zoological and botanical evidence.

These experiments are concerned with the effect of low temperature as a block to the action of the growing tip upon other parts of the plant. The method of experimentation consists in subjecting to a low temperature some portion of the plant between the inhibiting growing tip and the part which it inhibits, while the inhibiting growing tip and the inhibiting part which it is desired to isolate remain at the usual temperature. More specifically a portion, two centimeters or more in length of the stem, petiole, runner, etc., is surrounded by a coil of tubing through which flows a current of water, at a low, controlled temperature. In order to avoid injury, the diameter of the coil is made large enough so that it does not touch the plant, the portion to be inclosed is wrapped in tinfoil, the space between it and the coil is lightly packed with damp absorbent cotton, and finally the coil, together with the portion of the plant surrounded by it, is wrapped lightly with a bandage of dry raw cotton. In this way a localized region can be maintained at any desired temperature above zero with very slight variation, provided the temperature of the water flowing through the coil is kept constant. In the apparatus used in these experiments the temperature variation inside the coil can be controlled within one degree Centigrade. The plants are kept in a greenhouse at a temperature ranging from 20° to 25° C., while the region surrounded by the coil is kept at a much lower temperature, in most experiments at approximately 3° C., though in some cases temperatures as high as 5° or even 6° have been found effective.

The results of these experiments with low temperature are briefly as follows: It is a familiar fact that in *Bryophyllum* new plants develop from the notches of the leaves when

[1] McCallum, *Bot. Gaz.*, XL., 1905, attempted to block the correlative action by means of localized anesthesia and obtained results of great interest.

the leaves are separated from the parent plant and placed in water or in a saturated atmosphere. We have found that when a length of 2 to 3 centimeters of the petiole is kept at a temperature 2.5° to 3° and the leaf immersed in water at room temperature, the notches, or some of them, will develop into new plants, while the leaf is still attached to the parent plant. The low temperature does not visibly injure the petiole and after its removal the development of the notches may again be inhibited or retarded. Moreover, it can be shown in this way that each leaf exerts a correlative action upon the leaf opposite and to some extent upon other leaves near it, this action extending farther down the stem than upward. For example when the petiole of one leaf is kept at low temperature, development occurs not only in the notches of this leaf but in at least some of those of the opposite leaf and sometimes in some of the notches of the next pair above and of one or two pairs below, if these leaves are immersed in water. In general the effect upon other leaves of the physiological isolation of one leaf apparently decreases with increasing distance from the isolated leaf and more rapidly upward than downward.

Very commonly the development of the notches is less rapid in the leaf with the low temperature zone on its petiole than in the opposite leaf, although the two leaves themselves are at the same temperature. This difference in rate of development is probably due to the fact that the low temperature zone brings about some disturbance in the movement of nutrition to the leaf and so delays somewhat the development of its buds.

Young plants of the scarlet runner bean *Phaseolus multiflorus,* and Lima bean, *Phaseolus macrocarpus* have also been much used in these experiments with even more satisfactory results than *Bryophyllum.* In these species buds are present in the axils of the cotyledons, but in normal plants these buds never develop beyond minute outgrowths. When a length of 2 or 3 centimeters of the stem above the cotyledons and below the first pair of leaves is inclosed in a coil at 3°, 4° and usually even 5° C., these buds develop, although the plant above the zone of low temperature shows no wilting and at most only a slight retardation of growth for two or three days. Moreover, the development of all axillary buds above the zone of low temperature is inhibited as in normal plants, but the inhibiting factor is blocked by the low temperature zone, although water and nutritive substances obviously pass it. When the low temperature coil is removed from the stem the growth of the buds in the axils of the cotyledons may be again inhibited, and may be again started by replacing the low temperature. If, however, the physiological isolation by low temperature is maintained long enough to permit these buds to develop into shoots several centimeters long, they often continue to grow more or less rapidly after the low temperature is removed and in some cases may even inhibit the further growth of the chief tip. In these bean seedlings the effect of the low temperature zone is visible in the growth of the buds within one to two days.

In the same way other axillary buds at higher levels of the stem may be physiologically isolated and induced to develop, while the chief growing tip continues to grow and to inhibit all buds above the zone of low temperature. In most plants a temperature of 5° or 6° C., constitutes an effective block to the inhibiting action of the chief growing tip for several days, but these temperatures are near the upper limit of effectiveness for this species, and adjustment or acclimation of the cooled zone gradually occurs to such a degree that the buds which were at first physiologically isolated are again inhibited and cease to grow even before the low temperature is removed. When lower temperatures are used such acclimation may occur to some extent, but is less rapid.

Physiological isolation of the runner-tip of *Saxifraga sarmentosa* may also be brought about by low temperature. The runners of this plant, like those of the strawberry and various other forms, grow to a certain length, and then the bud at the tip of the runner develops into a new plant, and growth in length of the runner ceases. The more active the parent plant, the longer the runner grows

before its tip develops. When the plants are in good condition the runners attain a length of 20 to 30 centimeters or even more before development of the tip occurs. When the length of 2 to 3 centimeters of a growing runner is kept at a temperature of 3° to 4° C., development of the new plant usually begins within two to four days, and very little further growth in length of the runner occurs, even though its length is much less than the normal length of runner produced by the same plant. Since each plant produces numerous runners in succession, and since the normal length of runner at any given time is very definite, several runners, of both earlier and later origin than the experimental runner and from the same plant, may be used as controls. There is no wilting of the runner distal to the low temperature zone, and the tip evidently receives nutrition, for the growth and development of the new plant take place as rapidly as in normal runners which have attained their full length. It should be noted, moreover, that these runner-tips are not permitted to touch the ground and become rooted, but are kept suspended in air.

Work with this method is being continued and further results will be reported and apparatus and technique more fully described in later papers. The results already obtained, together with certain conclusions to which they point are summarized as follows: first, the inhibiting action of the growing tip of the plant upon other buds, or of a leaf upon buds on other leaves, as in *Bryophyllum*, can be blocked by a zone of low temperature which does not prevent the flow of water and nutritive substances; second, the block produced by the zone of low temperature does not involve any visible or permanent alteration of the tissues, but is wholly reversible; third, a temperature which is at first an effective block may become ineffective after a few days, because of acclimation of the cooled zone to that temperature; fourth, in view of the above facts it appears at least highly probable that the inhibiting action of growing tip, a leaf, or other active region of a plant, depends for its passage from point to point upon metabolically active protoplasm, rather than upon purely physical transportation in the fluids flowing through "preformed channels" in the plant. In other words, the mechanism of this physiological correlation appears to possess at least certain of the characteristics of a transmissive or conductive, as distinguished from a purely transportative mechanism.

C. M. Child,
A. W. Bellamy

SCIENTIFIC EVENTS

THE BRITISH NATIONAL PHYSICAL LABORATORY

Sir Richard Glazebrook, as already recorded in Science, resigned the directorship of the National Physical Laboratory, Teddington, which he has held since its inception in 1899 on September 18, his sixty-fifth birthday.

Sir Richard was principal of Liverpool University when he received the appointment to the laboratory, which was founded by the Royal Society, and was originally intended as an extension of Kew Observatory. When the new buildings were opened at Teddington in 1902 it had but two departments and a staff of twenty-six. At the present time the staff numbers about 600, and building operations are still in progress for the accommodation of new departments in research work.

As already announced Richard Glazebrook is succeeded by Professor Petavel, professor of engineering and director of the Whitworth Laboratory in the University of Manchester.

The London *Times* writes:

Sir Richard Glazebrook, who retires from the directorship of the National Physical Laboratory, has controlled its fortunes from its small beginnings in 1899 to its present great place in the scientific organization of the nation. It was first intended merely to carry out investigations required in connection with the manufacture and testing of instruments of precision, and in 1902, when it was moved to new buildings at Teddington, it had only two departments and a staff of twenty-six. It has now seven scientific departments, a secretariat, and a staff of over 600 persons. These deal with heat, optics, acoustics and molecular physics, with electricity, metrology, engineering, metallurgy, the forms of ships and aerial machines, and aero-dynamics. It is the supreme

scientific court of appeal and advice for all questions involving the physical properties of matter, the strength and quality of materials, gauges and standards. During the war it rendered invaluable service. In the financial year ending in March, 1918, the Ministry of Munitions alone paid it £42,000 for work done, and when it is remembered that the expenditure was not on manufacture, but merely on examining and testing, some measure of its service may be gained. Until last year the Royal Society was the governing body of the laboratory, and conducted its affairs with the assistance of a general board of thirty-six members, of whom twelve were nominees of industrial and commercial institutions. It was an almost ideal combination of science and industry, and Sir Richard Glazebrook gained the respect and admiration of his theoretical and practical masters. But the financial responsibility was heavy and increasing, and from April 1, 1918, the Department of Scientific and Industrial Research took over the burden. Fortunately under the new arrangement the department assumes only the control necessary for an accounting authority. Sir Richard will hand over to his distinguished successor, Professor Petavel, not only an institution of great and growing usefulness, but a tradition of harmonious co-operation between science and industry. He has provided the new Department of Scientific and Industrial Research with a working organization sufficient to justify their existence, and with a model on which we may suppose that their most successful creations, the Industrial Research Councils, have been formed.

THE DYE INDUSTRIES

DURING the course of its sessions at Philadelphia the Dye Section of the American Chemical Society, unanimously passed the following resolutions:

WHEREAS, The manufacture of dyes from coal tar distillates involves the same general processes and materials used in the manufacture of explosive and poison gases for military use,

Resolved, That the question of the importation of dyes and of intermediates from which they may be made is a military question,

Resolved, That the importation of such dyes, the bases from which dyes are made or the intermediate products produced in the manufacture of such dyes is a menace to the possible future defense of our country, for the reason that such importations foster and support in foreign countries which would furnish an enemy with essential munitions of war,

Resolved, That insofar as dyes or intermediates or coal tar distillates are allowed to be imported in time of peace, such importations prevent or discourage the establishment, development and maintenance of an industry that is essential to national defense in time of war,

Resolved, That a copy of these resolutions be submitted at once to the advisory committee of the American Chemical Society for such action as in its judgment the circumstances merit, with the suggestion that copies be sent to the President of the United States and the chairman of appropriate committees of the Congress.

WHEREAS, The American armies were factors in the victorious completion of the Great War *vs.* Germany, and

WHEREAS, The allied governments are placing corps of skilled chemists to oversee operations in the dyestuff plants in the occupied areas of Germany, and

WHEREAS, The American dyestuff industry is very much in need of any information that can be obtained to assist the development of this industry,

Now, therefore, be it resolved, That it should be brought to the attention of the President of the United States and an urgent request made that we have our share in the operating control of these factories and that we should have qualified representatives stationed there, the information gained to be used for the benefit of American industry.

Be it further resolved, That this tentative resolution be submitted at once to the Committee on National Policy of the American Chemical Society for such action as they think the circumstances merit.

WHEREAS, We find at the head of the laundry list of the Bellevue-Stratford Hotel the following notice: "Owing to dyes now being used, we will not assume any responsibility in the laundering of guests' apparel," and

WHEREAS, We find the similar lack of confidence in American dyes expressed by the department stores,

Now, therefore, be it resolved, That the Dye Section views with great disapproval the expression of any such misleading statements as to the quality of the American dyes,

Resolved, That this tentative resolution be submitted at once to the Committee on National Pol-

icy of the American Chemical Society for final but prompt action.

A COOPERATIVE COURSE IN ELECTRIC ENGINEERING

A COOPERATIVE course in electrical engineering, in which the General Electric Company combines with the institute has been established at the Massachusetts Institute of Technology. Students undertaking this work will have before them a course of five years in length. The first two are identical with the regular course in electrical engineering, and the last three will be divided between instruction in theory at the institute and instruction in practise at the West Lynn works of the General Electric Company. The regular four-year course will have certain omissions and abridgements, to make time for the work at Lynn, while the fifth year will be virtually postgraduate study with emphasis on problems of administration, project, design and research. The institute instructing staff has been strengthened by the addition to its electrical faculty of Professor Timble, who will be alternately at the institute and at the works with the students.

For the present class there will be eleven terms ahead, four terms a year. The first ten terms are to be spent in alternate study at the institute and at the works. The institute terms are of eleven weeks each, followed by two weeks' vacation, while the terms at the works in Lynn are of thirteen weeks each. One group of students will begin at the institute and the other at Lynn, and at the end of the term they will change places. The eleventh term, which is that just preceding commencement, will be spent by both groups at the institute. This, which is outside of the two preliminary years, will fill the time, and at the conclusion of the whole there will be an optional additional term of thirteen weeks at Lynn.

The successful completion of the course will lead to a degree of master of science, to be conferred at the graduation exercises of Technology, and the degree of bachelor of science will be conferred at the same time as of the preceding year.

This undertaking, which affords to the students the practise of the most important and largest kind of commercial work, is undertaken by the General Electric in order that it may have a supply of properly trained young men for its managers and superintendents.

THE CORNELL UNIVERSITY MEDICAL COLLEGE

THE Cornell University Medical College opened its twenty-second annual session on September 29, 1919. The annual address to the students was delivered by Dr. Graham Luck, professor of physiology. Two hundred and eighteen students are registered in the course leading to the degree of M.D., of whom 72 are registered for the first year in medicine in the New York City division of the medical college. There are in addition, forty medical students in the first year of medicine at Cornell University, Ithaca, N. Y., who will enter the New York City division for the second year, in 1921.

The college also announces the following appointments to the medical faculty in New York City.

E. F. DuBois, M.D., assistant professor of medicine, director of medicine, Bellevue Hospital.

Oscar M. Schloss, M.D., professor of clinical medicine, department of pediatrics.

Henry H. M. Lyle, M.D., assistant professor of surgery.

Jeremiah S. Ferguson, M.D., assistant professor of clinical medicine, department of pediatrics.

Nellis B. Foster, M.D., assistant professor of medicine and associate attending physician to New York Hospital.

John C. A. Cerster, M.D., assistant professor of clinical surgery.

Charles V. Morrill, A.M., Ph.D., assistant professor of anatomy.

Robert Chambers, A.M., Ph.D., assistant professor of anatomy.

THE LANE MEDICAL LECTURES

THE Lane Medical Lectures will be delivered this year by Dr. Alonzo E. Taylor, professor of physiological chemistry at the University of Pennsylvania. Dr. Taylor will speak on the "Feeding of the Nations at War." The lectures will take place at Lane Hall on Sacramento Street near Webster,

San Francisco, at 8 o-clock on the evenings of December 8, 9, 10, 11 and 12.

Dr. Alonzo Taylor was sent abroad under the auspices of the American Minister to make a scientific study of the care of the Allied prisoners in Germany. His reports were published by the British government in 1916 and 1917. At that time he was particularly interested in the food problems associated with nutrition of a people at war. Upon our entrance into the war he was one of the first men taken in by Mr. Hoover in the organization of the Food Administration. His particular problem was to coordinate the efforts of the Department of Agriculture and those of the newly established Food Administration. He was a member of the Committee on Research and on Public Health of the Food Administration and also a member of the commission sent abroad by this country to study the alimentation problems of the Allied nations. Subsequently he was the representative of the Department of Agriculture upon the War Trade Board. He made two different trips to Europe studying conditions there and since the armistice has been the representative of the Food Administration and the American Relief Administration particularly in the Balkan countries.

Dr. Taylor has written a series of articles dealing with various aspects of the war, particularly for the *Saturday Evening Post*. He is the author of a book on "War Bread" and with Dr. Kellogg published a book on "The Food Problem."

DINNER IN HONOR OF PROFESSOR CHAMBERLIN

A dinner in honor of Dr. Thomas Chrowder Chamberlin was given at the Chicago Beach Hotel, on September 27. The dinner was occasioned by the retiring to become professor emeritus of Professor Chamberlin from the headship of the department of geology in order that he might devote himself to the research in which he is interested. The date of the dinner was felicitous in that it was within a few days of Professor Chamberlin's seventy-seven birthday.

About fifty people, almost solely former students and intimate colleagues of the guest of honor, were present. Dr. G. F. Kay, of the University of Iowa, acted as toastmaster, and speeches were made by Dean Rollin D. Salisbury, of the University of Chicago, Dr. C. K. Leith, of the University of Wisconsin, and Dr. F. R. Moulton and President Judson, both of the University of Chicago. At the end of the dinner, the toastmaster handed to Dr. Chamberlin a great number of congratulatory telegrams from friends all over the world.

SCIENTIFIC NOTES AND NEWS

Mr. George H. Ashley, of the U. S. Geological Survey, has been appointed state geologist of Pennsylvania.

Dr. Samuel A. Tucker, formerly professor of electrochemistry at Columbia University, who served as major in the Chemical Warfare Service, has been appointed chief chemist for the Chemical Foundation, Inc.

Dr. Charles L. Parsons has resigned from the Bureau of Mines in order to give more time to the work of the secretaryship of the American Chemical Society. He will also undertake a limited amount of private consulting work.

Dr. Arthur F. Budington, of Brown University, and Dr. Ralph W. G. Wyckoff, of Cornell University, have become members of the staff of the Geophysical Laboratory of the Carnegie Institution.

Dr. Albert Mann, of Washington, D. C., has recently left the Department of Agriculture to accept a position with the Carnegie Institution of Washington. A recognition of the growing economic importance of the diatoms led the National Research Council to advise that plans be made to finance a thorough study of these aquatic plants. The Carnegie Institution received the suggestion favorably and Dr. Mann was invited to take up the work. His laboratory and office are located in the National Museum.

Dr. Christian R. Holmes, dean of the medical college of the University of Cincinnati, has announced his intention of retiring from

practise to devote his entire time to the work of the college.

Dr. L. H. Baekeland, honorary professor of chemical engineering in Columbia University, has been decorated by King Albert with the Order of the Crown of Belgium.

At the centennial celebration of Colgate University on October 11, James M. Taylor, professor of mathematics in the university since 1870, received the honorary degree of doctor of science.

Dr. George Emerson Brewer, formerly professor of surgery in Columbia University, has sailed for France, at the request of the Surgeon General, as a representative of the United States at the inter-allied congress of surgeons shortly to convene in Paris. For the next five weeks Dr. Brewer temporarily resumes his rank as colonel in the medical division of the army, but by the middle of November he will return to civilian status in New York.

Dr. Kirtley F. Mather, professor of geology at Denison University, will be on leave of absence for the current year to undertake geologic exploration for Richmond Levering & Co. His work at Denison will be carried on by Dr. James H. Hance, formerly of the International Revenue Bureau, Washington, D. C.

Sir Oliver Lodge, the British physicist, plans to visit the United States in the early spring of next year.

The National Research Council has appointed a committee on Pacific exploration to consider and organize cooperative research in the various fields in which investigation is under way in the Pacific area. The first meeting of this committee was held on September 10, at the University of California. In order that through combined effort of the institutions concerned the fullest measure of result may be secured, the committee is especially desirious of securing information as to investigations under way or projected in the Pacific area in fields of research ranging from physics to anthropology. The members of the Committee present at the California meeting were H. E. Gregory, George F. McEwen, W. E. Ritter and J. C. Merriam, chairman. Other members of the committee were unavoidably absent. A meeting of the full committee for the purpose of initiating the investigations planned for the coming year will take place on the Atlantic coast in December.

Of the seventeen members of the faculty of the school of engineering at the Pennsylvania State College, who entered military service, the following have returned to take up their work: Captain E. D. Walker, A. E. F., head of the department of civil engineering; Captain John J. Light, A. E. F., assistant professor of mechanical engineering; Captain M. E. Kressly, instructor in engineering drawing, and Lieutenant Charles B. Steel, R. W. Minshall, A. Edward Bryan, John C. Runk and R. B. Nesbitt.

Professor Mark Alfred Carleton, who recently resigned from his position of cerealist with the U S. Department of Agriculture, is now making special field investigations for the U. S. Grain Corporation, with headquarters at 42 Broadway, New York City. While connected with the Department of Agriculture, Professor Carleton accomplished much in the way of introducing and establishing new and important varieties of cereal grains which have very materially increased the grain production in the United States. Of these might be mentioned Durum wheat, the production of which now amounts to approximately fifty million of bushels annually, and also the Kharkov Hard Winter wheat, the Swedish Select and Sixty Day oats, and the Petkus and Abruzzes rye. These various cereal grains, mainly the results of Professor Carleton's exploration and survey of Russia and Central Europe, are now standard crops in this country. Of his more purely scientific results, might been mentioned: The discovery of a sixth spore form of the rusts, the amphispore: the demonstration of winter hardiness of the uredo stage of leaf rust of wheat, and the discovery of distinct physiological forms of rust—the latter being made simultaneously with Eriksson.

Dr. Cyril Hopkins, head of the department of agronomy of the University of Illinois,

died of malaria, at Gibraltar, on October 6. Dr. Hopkins was known as an international authority on soils. He had closed a year's work in reclamation studies of the worn soils of Greece and was on his way home when illness compelled his removal from the steamer.

THE British prime minister has written to Lord Ernle (Mr. R. E. Prothero) a letter on his resignation of the presidency of the Board of Agriculture. Mr. Lloyd George says: "On behalf of the government I wish to thank you for the invaluable services you rendered the country during your remarkable tenure of office. Your chieftainship at the board marked an epoch in the history of British agriculture. It was the beginning of a departure which will soon, not only restore British land cultivation to its past prosperity, but lead it on to even greater heights of achievement. I feel a great pride in the fact that your work was done entirely during my premiership."

PREPARATIONS are being made for a conference of physiologists at Paris in July, 1920. The meeting is being organized by representatives from Great Britain, France and America, and invitations are to be sent to the neutral nations.

A BILL has recently been passed by the Canadian House of Commons creating a Federal Department of Health. The bill provides for a minister of health, and an advisory council. The authority of the new department will extend to all matters affecting health within the jurisdiction of the Canadian government.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of the late Richard M. Colgate, Colgate University receives a bequest of $100,000 to be used for the erection of a dormitory. Mr. Colgate also left $100,000 to Yale for the establishment of a professorship "for the advancement of the intellectual teaching of freshmen students."

THE Bureau of Education has published a circular showing the increase of salaries of college teachers made during the last academic year and voted for the present year. Increases of ten per cent., or over for the last year are reported by 72 per cent. of the institutions for full professors, 51 per cent. for assistant professors and 52 per cent. for instructors. Of the institutions which reported an increase of over ten per cent. for the year 1920, 74 per cent. reported increases for full professors, 59 per cent. for assistant professors and 46 per cent. for instructors. It is noticeable that many larger institutions do not appear on the list of those which provided increases in salary in either year.

DR. DANIEL RUSSELL HADGDON, head of the Newark College of Technology, Newark, N. J., has been elected president of the Hahnemann College and Medical School, of Chicago. He is the author of works on "General Science," and "Applied Physics."

E. V. HUNTINGTON, associate professor of mathematics in Harvard University, has been promoted to a full professorship in mechanics. His teaching activities will be divided as heretofore between the division of mathematics and the division of engineering.

PAUL B. SEARS has accepted an assistant professorship of botany in the University of Nebraska and has begun his work there. He was formerly an instructor in the Ohio State University and during the war was a lieutenant in aviation. Previously he had been assistant in botany in the University of Nebraska.

DR. A. R. C. HAAS has been appointed associate professor of plant physiology in the University of California, Graduate School of Tropical Agriculture and at the Citrus Experiment Station at Riverside. He is engaged chiefly with studies in plant nutrition.

DR. B. W. WELLS, formerly of the University of Arkansas, has taken charge of the department of botany in the North Carolina State College. Mr. I. V. Shunk, of the University of West Virginia, has been appointed instructor in the same department.

PROFESSOR NEWLAND F. SMITH, of Centre College, Danville, Ky., has accepted a position as head of the department of physics in The Citadel, the Military College of South Carolina, at Charleston. He will commence his

work here as soon as his successor at Centre College is secured.

DR. H. L. IBSEN has been appointed assistant professor of animal husbandry, at the University of Wisconsin.

DR. FRANK C. GATES, formerly professor of biology at Carthage College, is now assistant professor of botany in charge of the herbarium at the Kansas State Agricultural College, at Manhattan Kansas.

MR. C. E. ALLRED has been appointed chief of the new Department of Agricultural Economics in the University of Tennessee. This department is to embrace all work done in farm economics, farm management and rural sociology. Research work in these subjects is being planned. Previous to taking up this work Mr. Allred was farm management specialist for Tennessee.

DR. WILLIAM F. PROUTY, assistant state geologist of Alabama since 1906, and professor of geology and mineralogy at the University of Alabama since 1912, has resigned to accept the professorship of stratigraphic geology at the University of North Carolina.

DR. DOUGLAS R. SEMMES, formerly professor of geology in the Agricultural and Mechanical College of Texas, and recently engaged in oil work in the Texas fields, has been elected associate professor of geology in the University of Alabama to fill the vacancy caused by the resignation of Dr. Prouty.

DISCUSSION AND CORRESPONDENCE

SNOW-ROLLERS

TO THE EDITOR OF SCIENCE: The wind-blown snowballs described by Mr. L. E. Woodman in your issue of August 30, p. 210–211, are known to meteorologists as "snow-rollers," and are rather frequently reported. The most extensive account of snow-rollers in the English language is that given in the *Quarterly Journal* of the Royal Meteorological Society, Vol. 34, 1908, p. 87–96. This is mainly a compilation of accounts of the phenomenon previously published in scientific books and journals, and is illustrated. Some of these accounts appeared in the Monthly Weather Review (published by the U. S. Weather Bureau). Probably the most important contribution to the subject of snow-rollers is the article "Schneewalzen," by Rudolf Meyer, in Korrespondenzblatt des Naturforscher-Vereins zu Riga, Vol. 52, 1909. This gives a list and analysis of all cases known to the writer between the years 1808 and 1909, and is accompanied by a bibliography which lists 35 previous papers on the subject in several languages.

C. F. TALMAN

U. S. WEATHER BUREAU,
WASHINGTON, D. C.

TO THE EDITOR OF SCIENCE: I was much interested in Professor Woodman's account of "A Snow Effect," in your issue of August 29. Years ago, at the time of the great blizzard in 1888, I saw the snow rolled up by the wind into pillow-like balls in Clay County, Kansas, and these snowballs were actually rolled uphill. The wind was very strong from the northwest and the snowballs were formed on slopes facing the northwest. The following note is taken from my diary of the time:

January 12, 1888.—In the morning we had wind and snow from the southeast, which gradually changed to the southwest. The snow was very soft and moist and about six inches deep. At three o'clock P.M. the wind changed to the northwest, blowing very strong and cold, which rolled the snow up into large rolls like pillows, some being two feet in diameter and three feet long, and some even larger. In some places more than a dozen could be counted on a square acre.

These pillow-like balls were narrow in the center and became wider toward the outside, leaving a sort of funnel-like depression at each end.

JOHN H. SCHAFFNER

DEPARTMENT OF BOTANY,
OHIO STATE UNIVERSITY

TO THE EDITOR OF SCIENCE: A snow effect similar to that reported by Professor Woodman in your issue of August 29 occurred last spring at Fort Snelling, Minnesota.

The parade ground at the Fort was dotted one morning by snow balls. I thought, on

first seeing them, that the men had been discharging their excess energy by playing in the snow, and that the balls merely marked the beginning of a snow fort.

As I approached the parade ground, however, I noted, first, the absence of footprints in the snow; second, that the paths of the balls were in general parallel, and third, that the "balls" were rolled in one direction only, like cotton batting or a bundle of rugs, and that they were properly speaking "rolls" instead of "balls." So I was forced to the conclusion that they were the effect of the wind.

On questioning the old inhabitants of the Fort I learned that they were indeed wind-blown, and that such effects occurred not infrequently there.

The "balls" or "rolls" varied greatly in size. Some were over three feet in diameter, but the majority were smaller, about two feet. The largest one that I saw was about four feet in diameter and two feet thick.

They were all bi-concave. The paths in their wakes were triangular in shape, and varied greatly in length, depending of course on the size of the ball. The path of the large roll mentioned above was over fifty feet in length.

All the larger balls had fallen on one side, showing that size was not so much a matter of wind-power as it was of balance.

There were about three inches of soft snow on the ground, and the velocity of the wind was nearly cyclonic.

Karl M. Dallenbach

Cornell University

A WALL-SIDE MIRAGE

To the Editor of Science: Dr. Knowlton's note on "An unusual mirage" in Science for October 3, suggests mention of a mirage on a vertical north-south wall, on Garden Street, Cambridge, when the warm afternoon sun shines on it in quiet weather. If the observer stands close to the plane of the wall, he can easily see a mirror-like reflection of the elbow or of the side profile of a person who is walking near the wall, fifty or a hundred feet away.

W. M. Davis

QUOTATIONS

THE BRITISH ASSOCIATION

The authorities of the British Association for the Advancement of Science have made known their satisfaction with the meeting at Bournemouth, which ended last Saturday. This judgment doubtless was determined by the old standard, which, even before the war, was neither high nor rising. A warm welcome from the beautiful town, convenient arrangements for the meetings, summer weather, and nearly 1,500 members, including quite a number of scientific men, plenty of attractive subjects dealt with by speakers who "drew," and excursions with a decent scientific pretext—such were the materials that produced success. It is to be noticed that they would have suited the requirements of almost any kind of congress. It is more difficult to distinguish in them the "differentia" of a meeting for the advancement of science. Where revelations of the secrets of the war had been promised, there the visitors thronged. The vast growth of naval engines and armaments, hydrophones in fish-like cases, paravanes, sound ranging devices, airships and aeroplanes, tanks and submarine mines, poison gas and high explosives, excited and delighted the members of the British Association precisely as they would have excited and delighted the general public. There was a refrain of the achievements of British men of science, as opposed to the vaunted science of Germany, but there was very little of detailed scientific statement or discussion of methods. Almost equally popular were the items in the Educational Section. Sir Robert Blair on continuation schools, Bishop Welldon on citizenship, General Baden-Powell on the Boy Scout movement, other speakers on the advantages of private schools or the benefits of a sound knowledge of English, received and deserved attention. In mentioning a few other examples of the subjects that attracted large audiences we throw no doubt on the value of knowledge on the political bearings of international rivers, the use of hypnotism in treating shell-shock, or whether or not the working day should be

determined by legal enactment. But these, in fact, and as they were presented, have only a remote connection with science.

There is a double reason for the inconspicuous appearance of the scientific side at meetings of the British Association for the Advancement of Science. The results of research, if they are to be useful to other workers, or even if they are to increase the scientific reputation of their authors, must receive quick and effective publication. The organ of the British Association is a bulky annual volume, costly to buy, slow to appear, and cumbrous on private shelves. Prudent investigators prefer other means of making known their work, and hence offer to the association very little that is new. The traditional policy of successive councils, or more probably of the general officers who are the effective managers of the association, has been to cater for numbers rather than for quality. Hence the tendency in favor of the popular. Hence the continuous increases in the numbers of the sections and sub-sections, the wish to provide for any subject that can be alleged to have a connection with science. The theory no doubt is that these outer circles should be infiltrated with the scientific spirit. The practical result is that many papers are accepted by the British Association which are better suited, were they certain of acceptance, to specialized congresses, or to local debating societies. An excuse that is offered for this policy is that large attendances mean large receipts and the possibility of making large grants for more research. A sum of over £1,300, it is proudly stated, is to be provided for research by reason of the success of the Bournemouth meeting. Twelve sectional committees put in their claims on it, and a general committee, supposed to contain, and actually containing, some of the best brains in Great Britain, had to meet in solemn conclave to allot this vast sum.

The British Association does some good work. It could do much more. It serves as a meeting ground of men engaged in different branches of science. Were they not swamped by the camp-followers and separated by subdivision, they could really come together for the double purpose of social contact and of discussion of the technical methods on which the progress of science depends. It is the great annual opportunity for the publicity of scientific work. The more necessary that it should avoid the popular "copy" which has always a ready access to the lay organs of publication. The more vital that it should present the highest aims and needs of science. What is most vital is that it should insist on the advancement of science simply as knowledge, and not merely as a means to practical utilities. Certainly in the recesses of some of the sectional meetings, and in a few of the formal addresses, there was insistence on pure as opposed to applied research. But the small voice of the true scientific spirit was drowned by the resounding advertisement of the practical utilities that had come from science. Moreover, it frequently became shrill with personal protest—protest from scientific men who thought that they had been neglected or controlled by "practical" men. We do not dispute that the protests were sometimes just, and that it may have been useful to make them. But the nation, and perhaps even the government, which is a very different thing, will listen more readily to science at its best. And the best voice of science is neither protest, promise, nor boasting, but the proclamation of the intrinsic worth of knowledge spoken with faith and imagination.—The London *Times*.

SCIENTIFIC BOOKS

Un manuscrit inédit de Dolomieu sur la minéralogie du Dauphiné. Grenoble, imprimerie Allier Frères, 1919, 50 pp. 8vo.

We are indebted to Professor Alfred Lacroix, Secretaire Perpétuel of the Académie des Sciences, for the publication of an inedited manuscript of Déodat de Dolomieu. This treats of the mineralogy of the old province of Dauphiné, and embodies notes sent to Dolomieu by the city librarian of Grenoble, Du Cros. As a little of the nomenclature has become obsolete, Professor Lacroix has here and there supplied (in parentheses) the modern equivalents, and in a very brief

introductory note he gives a few details regarding the manuscript, which he believes was written in 1795 or 1796. One of the most interesting of Dolomieu's statements regards the gold deposits of La Gardette, an elevation in the southern part of Dauphiné.[1] Here gold was found in a quartz vein traversing a gneissic formation, at about 1,500 feet above the plain of Bourg d'Oisans, in the present department of Isère. As early as 1717 peasants are said to have picked up here yellow stones which when assayed in Grenoble were found to contain gold. In 1778 serious attempts were made to work this vein and a certain quantity of gold was extracted, a part of which was sent in the form of an ingot to the Comte de Provence, later Louis XVIII, who caused a medal to be struck out of this gold.[2]

G. F. K.

NOTES ON METEOROLOGY AND CLIMATOLOGY

THE TRANS-ATLANTIC FLIGHTS AND OCEAN WEATHER MAPS

ALTHOUGH some attempt has been made to post daily weather maps of the North Atlantic in the New York Customs House, the occasions of trans-Atlantic flights first brought forth daily weather maps of the North Atlantic from which oceanwide forecasts were made. In fact, for a short time in the middle of May such weather maps were being made every six hours from weather reports received by radio from European and American land stations and from the five American battleships and ten destroyers spread over the Atlantic between latitudes 36° and 51° N.

Unfavorable winds for the flight of the NC planes to the Azores lasted until May 16, when in the rear of a low pressure trough, fair weather and westerly winds prevailed from Newfoundland nearly to the Azores. Thinking (justifiably, as it proved) that such favorable conditions would not last long and would not continue again for some time, the forecasters advised that conditions were favorable for the start of the flight to the Azores. The second stage of the flight of the NC-4 to Lisbon was delayed till the twenty-seventh, when a following wind appreciably shortened this long flight. A detailed account of "The first trans-Atlantic flight," with 14 weather maps of the North Atlantic, May 12–20 and 27–31 and of the forecasts in this connection, by W. R. Gregg and E. H. Bowie have been published in the *Monthly Weather Review*, May, 1919, pp. 279–282, 347.

In addition to such weather information as the Americans gave the British aviators on this occasion, the British Meteorological Office was actively engaged in getting weather reports from merchant ships on the ocean along the route from Newfoundland to Ireland. As many have no radio outfits, and as only an occasional ship can send reports more than a few hundred miles, the conditions along this course have been but poorly known in time to be helpful. Stormy weather on either coast kept aviators from starting, but the lack of stormy conditions on either coast did not mean safety in mid-ocean. Messrs. Hawker and Grieve, after leaving Newfoundland, May 18, ran into the northern part of the storm which was so distressing to the crew of the NC-3. In spite of climbing to a considerable height they were unable to get above the clouds; and the strong north wind hindered their progress appreciably.[11]

Although Messrs. Alcock and Brown also experienced considerable cloudiness, the wind conditions, strong westerly all the way, appear to have been ideal for their flight from Newfoundland to Ireland, June 14–15. If they flew on a great circle course the average speed was about 120 miles an hour.[12]

By the time the R-34 was ready to make its trip to America, the receipt of weather reports by radio from vessels at sea was better, though there were great stretches from which no in-

[1] *Op. cit.*, pp. 16–20.

[2] In Professor Lacroix's great work "Minéralogie de la France et de ses Colonies," Vol., 1897, p. 422, this medal is figured.

[11] See *Monthly Weather Review*, May, 1919, p. 283.

[12] See account and weather maps in the *Monthly Weather Review*, June, 1919, p. 416, charts X. and XI.

formation was to be had. The weather forecasters, nevertheless, were able to pick favorable times for the trips both coming and going. The encounters with thunderstorms on the American coast, and the danger of ignition of the hydrogen by lightning have caused a call for thunderstorm statistics over the oceans. Fortunately, thunderstorms are much less numerous on coasts than inland. The danger to trans-oceanic dirigibles, however, is present the year round, and both night and day, for land thunderstorms, which may drift a short distance out to sea occur mostly by day in summer, and ocean thunderstorms occur mostly at night and in winter. Mr. W. R. Gregg, the Weather Bureau representative at Mineola during the stay of the R34, has prepared an account of the meteorological aspects of the voyage of the R34.[13]

I quote from his synopsis:

> The British dirigible R34 flew from the British Isles to the United States in 108 hours and made the return trip in 75 hours, a good illustration of the influence of the prevailing westerlies in trans-Atlantic flight. During the first day of the westward trip northeasterly and easterly winds furnished some assistance, but thereafter cross winds or head winds were encountered most of the time. On the return trip southwesterly and westerly winds added considerably to the air speed of the ship. Inasmuch as it was necessary to moor the ship in the open at Roosevelt Field [it was necessary to guard against] . . . the sea breeze, thunder-storms, and alternate heating and cooling of the gas through the interruption of insolation by passing clouds.

The British have now taken steps to inaugurate a radio collecting and issuing system for weather reports and forecasts for marine and aeronautical interests in all parts of the world.[14]

CHARLES F. BROOKS

WASHINGTON, D. C.

13 *Monthly Weather Review*, August, 1919; daily North Atlantic weather maps by F. A. Young in July issue.

14 See *Symon's Meteorological Mag.*, May, 1919, pp. 37–38; noted in *Geog. Rev.*, June, 1919, p. 421, and reprinted in *Mo. Weather Rev.*, June, 1919, p. 417.

SPECIAL ARTICLES

NEW FRUIT FUNGI FOUND ON THE CHICAGO MARKET

THE present paper gives a description of the diseases as they were seen on the fruit rather than a study of the fungus itself.

The new fruit diseases found on the Chicago market are as follows: a new *Botrytis* on apple, *Polyscytalum* on grapefruit and *Fusarium* on grapefruit.

Botrytis sp. was first isolated from a northwestern Spitzenburg, and later found on northwestern Arkansas Black and Winesap. Five Spitzenburg apples affected with *Botrytis* were taken from the same box.

The affected Spitzenburgs were entirely rotted. The apples were very soft but the rot was firmer than that produced by *Penicillium*. The pigments of the skin had stained the underlying tissues to a depth of a quarter of an inch. The apples were covered with a very fine white growth of decumbent mycelium.

In 1918 *Botrytis* sp. was studied at the University of Illinois. The species of *Botrytis* was isolated from an apple covered with a thick, heavy growth of grayish mycelium. The fungus tufts arose a half an inch from the surface of the apple. Inoculations of conidiospores upon disease free fruit produced similar growths. The conidiospores averaged 6μ in diameter. The conidiospores of the *Botrytis* in the present paper averaged 4μ in diameter. As far as the writer has been able to learn, no *Botrytis* of this dscription has ever been recorded.

The perfect and the imperfect stage of *Botrytis* sp. develops in the same culture tube. The asci are arranged in a layer which constitutes a convex hymenium. The hymenium is formed on a very loose structure of mycelium. Paraphyses are present. There were no ascospores produced during the four months the fungus was under observation. The asci averaged $51\mu \times 11.5\mu$. Sclerotia are seen in culture with the naked eye at the end of two weeks.

Five series of inoculation tests were made using the Spitzenburg variety of apple. Ten apples were used each time. Care was taken

to have the apples in as sterile a condition as possible. The apples were washed thoroughly in tap water, allowed to remain in mercuric chloride (1: 1,000) for five minutes, washed in water that had been boiled, then rinsed in 95 per cent. alcohol. Two punctures were made on each apple with a sterile platinum needle. The inoculum of conidiospores was applied to each puncture with a sterile loop needle. The inoculated apples were placed in a sterile granite pan and covered over with a similar pan. The total diameter in millimeters of the spots on the ten apples was recorded. The five series of inoculations were averaged and the results recorded in the following table:

Apples inoculated on May 10: May 13, 140 mm.; May 15, 414 mm.; May 17, 788 mm.; May 19, 1,060 mm.; May 21, 1,386 mm.

POLYSCYTALUM ON GRAPEFRUIT

Polyscytalum has only been found on the market three times and as yet is not a disease of importance.

The fungus was isolated from a slightly sunken soft area one half an inch in diameter. The spot was of a little lighter color than the color of the fruit itself. The spot has the appearance of a blister filled with water. In the early stages of the disease the rot works down to the pulp of the fruit in a perpendicular manner. The affected tissue is very soft, more so than that attacked by *Penicillium*. When a spot has reached the diameter of 20 or 25 millimeters the fungus begins to attack the pulp of the fruit. An attacked fruit soon becomes a soft mushy mass.

Five series of inoculations were made using four grapefruits in each series. The average development of a spot is shown as follows: fruit inoculated May 10, May 17, 55 mm.; May 19, 49 mm.; May 21, 70 mm.; May 23, 91 mm.

GRAPEFRUIT FUSARIUM

Fusarium sp. was first found on a shipment of Florida grapefruit. The fungus was found enough on the Chicago market to classify it as a disease of economic importance.

The isolation was made from a tan to reddish brown rough sunken area an inch in diameter. The tissue underneath was dry, corky, and of a tan color extending inward an eighth of an inch. These rough sunken areas often reach the size of two and a half by one and a half inches. In the case of the larger spots the fungus often develops down into the pulp of the fruit causing a rot. A black and pink development is made in the host tissue. A very fine white cottony growth often develops in the pulp of the fruit and sometimes on the surface of the brown rough area.

Ten series of inoculations were made using three grapefruit in each inoculation. The average growth of a spot is shown as follows: fruit inoculated April 24, May 1, 5 mm. in diameter; May 19, 10 mm.; May 29, 17 mm.; June 2, 20 mm. It is seen that a *Fusarium* spot develops very slowly. However, in fifty per cent. of the inoculations when a spot had reached a diameter of twenty of twenty-five millimeters a rot developed at the edge of the sunken area. When *Fusarium* acts in this manner it is very serious, for a grapefruit will be a worthless rotten mass within forty-eight hours after the rot has started.

In order to discover what fruit diseases are of economic importance one has to study them from a market point of view as well as in the field. Some diseases are field infections which develop and spread under transit and storage conditions. A more complete study of fruit diseases as occuring on the market will reveal many diseases as yet unknown to plant pathologists.

HAROLD E. TURLEY
U. S. DEPARTMENT OF AGRICULTURE

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SCIENTIFIC EDUCATION AND THE TEACHING OF PHYSICS[1]

THE real cause of the prevailing neglect of science, with all its pernicious results, is that almost all our political leaders have received the most favored and fashionable form of public school education, and are without any scientific education. An education in classics and dialectics, the education of a lawyer, may be a good thing—for lawyers; though even that is doubtful. For the training of men who are to govern a state whose very existence depends on applications of science, and on the proper utilization of available stores of energy, it is ludicrously unsuitable. We hear of the judicial frame of mind which lawyers bring to the discussion of matters of high policy, but in the majority of scientific cases it is the open mind of crass ignorance. The result is lamentable: I myself heard a very eminent counsel declare in a case of some importance, involving practical applications of science, that one of Newton's laws of motion was that "friction is the cause of oscillations"! And the helpfulness of some eminent counsel and judges in patent cases is a byword.

As things are, eminence in science is no qualification, it would even seem to be a positive disqualification, for any share in the conduct of the affairs of this great industrial country. The scientific sides of public questions are ignored, nay, in many cases our rulers are unconscious of their existence. Recently in a discussion on the Forestry Bill in the House of Lords a member of that illustrious body made the foolish assertion that forestry had nothing to do with science; all that was needed was to dig holes and stick young trees into them. Could fatuity go further?

[1] Concluding part of the address of the president to the Mathematical and Physical Science Section at the Bournemouth meeting of the British Association for the Advancement of Science.

This hereditary legislator who, as things are, has it in his power to manage, or mismanage, the conversion into available energy of the radiation beneficently showered on a certain area (his area) of this country of ours does not seem to be aware that the growing of trees is a highly scientific industry, that there are habits and diseases of trees which have been profoundly studied, that, in short, the whole subject of silviculture bristles with scientific problems, the solutions of which have by patient labor been to a considerable extent obtained.

Take also the case of the dyes industries. The publicists and the good business men—the supermen of the present age—who wish to control and foster an industry which owes its very existence to an English chemist, refuse to have on the committee which is to manage this important affair any man of scientific eminence, and no remonstrance has any effect. These great business men are as a rule not scientific at all. They are all very well for finance, in other respects their businesses are run by their works-managers, and, in general, they are not remarkable for paying handsomely their scientific assistants.

I myself once heard it suggested by an eminent statesman that an electrical efficiency of 98 per cent. might by the progress of electrical science be increased fourfold! This, I am afraid, is more or less typical of the highly educated classical man's appreciation of the law of conservation of energy; and he is, save the mark, to be our minister, or proconsul, and the conservator of our national resources. It is not surprising, therefore, that in connection with a subject which for several weeks occupied a great space in the newspapers, and is now agitating a large section of the community, the nationalization of our coal mines, there was not a single word, except perhaps a causal vague reference in the report of the chairman, to the question, which is intimately bound up with any solution of the problem which statesmen may adopt, I mean the question of the economic utilization, in the interests of the country at large, of this great inheritance which nature has bestowed upon us. In short, are Tom, Dick and Harry, if we may so refer to noble and other coalowners, and to our masters the miners, to remain free to waste or to conserve at their own sweet will, or to exploit as they please, this necessity of the country's existence?

The fact is that until scientific education has gone forward far beyond the point it has yet reached, until it has become a living force in the world of politics and statesmanship, we shall hardly escape the ruin of our country. The business men will not save us; as has been said with much truth, the products of modern business methods are to a great extent slums and millionaires. It lies to a great extent with scientific men themselves to see that reform is forthcoming; and more power to the guild of science and to any other agency which can help to bring about this much-needed result.

While scientifically educated men, whether doing special work or acting as officers, have been held of far slighter account in the services than they ought to have been, for physicists as such there has been little or no recognition, except, I believe, when they happened to be ranked as research chemists! How did this happen? Why, the various trades asserted themselves, and the result was a sufficiently long list of "reserved occupations," a list remarkable both for its inclusions and for its exclusions. There was, for example, a class of "opticians," many of whom have no knowledge of optics worth mentioning. They are merely traders. One of these, for example, the proprietor of a business, made a plaintive appeal to myself as to how he could determine the magnifying powers of certain field-glasses which he wished the Ministry of Munitions to purchase. But for a young scientific man, even if he were an eminent authority on theoretical and practical optics, but who was not in the trade, there was no place.

Research chemists received their recognition in consequence of the existence of the institute of chemistry. I am extremely glad to find that something is now being done to found an institute of physics. I hope this movement will be successful, and that it will be thoroughly practical and efficient. I hope

its president and council, its members and its associates, will be jealous for science, and especially for physics. It ought to be a thoroughly hard-working body, without any frills, destitute of work value. They have an example in the General Medical Council, which has so effectively cared for the interests of the medical profession.

I am glad that something is being done at last for the organization of scientific research. This movement has started well in several, if not in all, respects, and I wish it all success. There are, however, one or two dangers to be avoided, and I am not sure—I may be much too timid and suspicious—that they are fully recognized, and that the result will not be too much of a bureaucracy. Somehow or other I am reminded by the papers I have seen of the remark of a poor man who, asking charity of some one in Glasgow, was referred to the Charity Organization Society of that city. "No, thank you," he said: "there is a good deal more organization than charity about that institution." So I hope that in the movement on foot the organization will not be more prominent than the science, and the organizers than the scientific workers.

There is to my mind too much centralization aimed at. Everything is to be done from London: a body sitting there is to decide the subjects of research and to allocate the grants. There may be a good deal to be said for that in the case of funds obtained in London. But apparently already existing local incentives to research work are to be transferred to London. The Carnegie Trust for the Universities of Scotland, soon after its work began, inaugurated a scheme for research work in connection with these universities. The beneficiaries of the trust, it is well known, must be students of Scottish nationality. The action of the trust has been most excellent, and much good work has been done. Now, so far as chemistry and physics are concerned, it has been proposed, if not decided, to hand over to the organization in London the making of the awards, a process of centralization that will probably not end with these subjects. I venture to protest against any such proceeding. The more incentives and endowments of research that exist and are administered in the provinces the better. Moreover, this is a benefaction to Scottish students which ought not to be withdrawn and merged in any provision made for the whole country, and administered in London by a bureau which may know little of the Scottish universities or of Scottish students. The bureau might, with equal justice or injustice, be given command of the special-research scholarships of all the universities both in England and Scotland, and administer them in the name of the fetish of unification of effort. I do not know, but can imagine, what Oxford and Cambridge and Manchester and Liverpool would say to that. But even Scotland, where of course we know little or nothing about education of any kind, may also have something to say before this ultra-centralization becomes an accomplished fact.

There is, it seems to me, another danger to be avoided besides that of undue centralization in London. In most of the statements I have seen regarding the promotion of research work the emphasis seems to be on industrial research, that is in applied science. This kind of research includes the investigation of physical and chemical products of various kinds which may be used in arts and manufactures, and its deliberate organized promotion ought to be a commercial affair. I observed, by the way, with some amusement, that according to the proposals of one committee for applied science, which is prepared to give grants and premiums for researches and results, the professor or head of a department, from whom will generally come what are most important, the ideas, is to have no payment. He is supposed to be so well paid by the institution he belongs to as to require no remuneration for his supervision of the committee's researches. And the results are to be the sole property of the committee!

There is in this delightfully calm proposal at least a suggestion of compulsion and of interference with institutions and their staffs, which ought to be well examined. Also some light is thrown on the ideas of such people as

managing directors of limited liability companies, who are members of such a committee, as to what might reasonably be expected of men of high attainments and skill, whose emoluments taken all round are on the whole miserably insufficient.

I think that it is in danger of being forgotten that, after all, pure science is by far the most important thing. Most of the great applications of science have been the products of discoveries which were made without any notion of such an outcome. Witness the tremendous series of results in electricity of which the beginning was Faraday's and Henry's researches on induction of currents, and the conclusion was the work of Hertz on electric waves. From the first came the production and transmission of power by electricity, from the last the world has received the gift of wireless telegraphy. I am not at all sure whether the great men who worked in the sixty or seventy years which I have indicated would have always received grants for proposed researches, which to many of the good business directors and other supermen serving on a great bureau of investigation, had such then existed, would have appeared fantastic and visionary. In research, in pure science at least, control will inevitably defeat itself. The scientific discoverer hardly knows whither he is being led: by a path he knows not he comes to his own. He should be free as the wind. But I must not be misunderstood. Most certainly it is right to encourage research in applied science by all available and legitimate means. But beware of attempting to control or "capture" the laboratories of pure science in the universities and colleges of the country. Let there be also ample provision for the pursuit of science for its own sake; the return will in the future as in the past surpass all expectation.

I had intended to say something about scientific education as exemplified by the teaching of physics. I have left myself little time or space for this. I can not quite pass the matter over, but I shall compress my remarks. In the first place I regard dynamics, especially rotational dynamics, as the foundation of all physics, and it is axiomatic that the foundation of a great structure should be soundly and solidly laid. The implications of dynamics are at present undergoing a very strict and searching examination, and now we may say that a step in advance has been taken from the Newtonian standpoint, and that a new and important development of dynamics has come into being. I refer of course to the new theories of relativity, which are now attracting so much attention. I hope to learn from the discussions, which we may possibly have, something of the latest ideas on this very fundamental subject of research. It is a matter for congratulation that so many excellent accounts of relativity are now available in English. Some earlier discussions are so very general in their mathematical treatment and notation as to be exceedingly difficult to master completely. I have attacked Minkowski's paper more than once, but have felt repelled, not by the difficulties of his analysis, but by that of marshalling and keeping track of all his results. Einstein's papers I have not yet been able to obtain. Hence it is a source of gratification to have Professor Eddington's interesting Report to the Physical Society and the other excellent treatises which we have in English. But continual thought and envisaging of the subject is still required to give anything approaching to instinctive appreciation such as we have in ordinary Newtonian dynamics. I venture to say that the subject is preeminently one for physicists and physical mathematicians. In some ways the new ideas bring us back to Newton's standpoint as regards so-called absolute rotation, a subject on which I have never thought that discussions of the foundations of dynamics had said absolutely the last word.

The better the student of physics is grounded in the older dynamics, and especially in the dynamics of rotation, the sooner will he be able to place himself at the new point of view, and the sooner will his way of looking at things begin to become instructive.

With regard to the study of physics in our universities and colleges, I had written a good deal. I have put that aside for the present,

and will content myself with only a few general observations. First, then, it would, I think, be conducive to progress if it were more generally recognized that dynamics is a physical subject, and only secondarily a mathematical one. Its study should be carried on in the departments of physics, not in those of mathematics or in separate departments of applied mathematics. It is, or ought to be, essentially a subject of the physical lecture-room and the physical laboratory. The student should be able to handle rotating bodies, to observe and test the laws of precession and nutation, to work himself, in a word, into an instinctive appreciation of at least the simpler results of rotational theory. He should learn to think in vectors, without necessarily referring either to Hamilton or to Grassmann. Some people appear to censure the use of vector ideas without the introduction at the same time of some form of vector notation. I do not feel drawn to any system of vectors in particular—all have their good points, and in some ways for three dimensional work the quaternion analysis is very attractive—but vector *ideas* are of the very utmost importance.

Hence I deprecate the teaching, however elementary, which as a beginning contents itself with rectilineal motion. The true meaning of rate of change of a directed quantity, even of velocity and acceleration, is missed, and instead of having laid a foundation for further progress the teacher, when he desires to go beyond the mere elements, has practically to relay his foundations, has in fact to extract imperfect ideas from his pupils' minds and substitute new ones, with the result that a great deal of avoidable perplexity and vexation is produced. The consideration of the manner of growth of vectors—the resultant vector or it may be component vectors, according to convenience—is the whole affair. As an illustration of what I mean, take this: A vector quantity has a certain direction, and also a magnitude L. It is turning in a certain plane with angular speed ω. This turning causes a rate of production of the vector quantity about a line in that plane and perpendicular to the former, and towards which the former is turning, of amount $L\omega$. Thus a particle moving in a curve with speed v has momentum mv forwards along the tangent at the position of the particle. The vector is turning towards the principal radius (length R) of curvature at the point at rate v/R. Hence towards the center of curvature momentum is growing up at time rate mv^2/R.

Dealt with in this way, with angular momentum instead of simple momentum, the motions of the principal axes of a rigid body give the equations of Euler instantly and intuitively, and all the mind-stupefying notions of centrifugal couples, and the like, are swept away.

With regard to mathematics, the more the physicist knows the better, and he should continually add to his store by making each physical subject he takes up a starting-point for further acquisition. Some very philistine notions as to mathematics prevail, and are very mischievous. For example, I once heard an eminent practical engineer declare that all the calculus an engineering student requires could be learned in an hour or two. This is simply not true, nor is it true, as some exponents of ultrasimplicity seem to suggest, that the professional mathematical teacher wilfully makes his subject difficult in order to preserve its esoteric character. Like the engineer or physicist himself, he is not always so simple as he might be; but the plain truth is that no good progressive mathematical study can be carried out without hard and continued application of the mind of the student to the subject. And why should he depend on the mathematical teacher? Let him be his own teacher! There are plenty of excellent books. If he has a determination to help himself he will, if he makes a practise of reserving difficulties and returning to them, find them vanish from his path.

As I have said, I am specially interested in rotational dynamics. In the course of the war I have been appalled by the want of appreciation of the principles of this subject, which, in spite of considerable acquaintance with the formal theory, seemed to prevail in some quarters. I don't refer to mistakes made

by competent people—it is human to err—but to the want of appreciation of the true physical meaning of the results expressed by equations. A gyrostat as ordinarily considered is a closed system, and its dynamical theory is of a certain kind. But do away with the closedness, and the dynamical theory is quite a different affair. Take, as an example, the case of two interlinked systems which are separately unstable. This compound system can be made stable even in the presence of dissipative forces. A certain product of terms must be positive, so that the roots of a certain determinantal equation of the fourth degree may all be positive. The result shows that there must be angular acceleration, not retardation, of the gyrostat frame. This acceleration is a means of supplying energy from without to the system, the energy necessary to preserve in operation the functions of the system.

I have ventured to think this stabilizing action by acceleration of the compound motion very important. It is lost sight of by those who consider and criticize gyrostatic appliances from the usual and erroneous point of view. Also I believe that it is by analogy a guide to the explanation of more complicated systems in the presence of energy-dissipating influences, and that the breaking down of stability or *death* of the system is due to the fact that energy can no longer be supplied from without in the manner prescribed for the system by its constitution.

I had just concluded this somewhat fragmentary address when the number of *Nature* for July 24 came to hand, containing a report of Sir Ernest Rutherford's lecture at the Royal Institution on June 6. The general result of Sir Ernest's experiments on the collision of α-particles with atoms of small mass is, it seems to me, a discovery of great importance, whatever may be its final interpretation. The conclusion that "the long-range atoms arising from the collision of α-particles with nitrogen are not nitrogen atoms, but probably charged atoms of hydrogen or atoms of mass 2," is of the utmost possible interest. The α-particle (the helium atom, as Rutherford supposes it to be) is extraordinarily stable in its constitution, and probably consists of three helium nuclei each of mass 4, with two attached nuclei of hydrogen, or one attached nucleus of mass 2. The intensely violent convulsion of the nitrogen atom produced by the collision causes the attached nuclei, or nucleus, to part company with the helium nuclei, and the nitrogen is resolved into helium and hydrogen.

It seems that, in order that atoms may be broken down into some primordial constituents, it is only necessary to strike the more complex atom with the proper kind of hammer. Of course, we are already familiar with the fact that radio-active forces produce changes that are never produced by so-called *chemical* action; but we seem now to be beginning to get a clearer notion of the *rationale* of radio-action. It seems to me that it might be interesting to observe whether any, or what kind of, radiation is produced by the great tribulation of the disturbed atoms and continued during its dying away. If there is such radiation, determinations of wave lengths would be of much importance in many respects.

I may perhaps mention here that long ago, when the cause of X-rays was a subject of speculation, and the doctrine that mainly found acceptance was that they were not light waves at all, I suggested to the late Professor Viriamu Jones that radiation of extremely small wave length would be produced if atomic or molecular vibration, as distinguished from what in comparison might be called molar vibration, could be excited. An illustration that suggested itself was this: Take a vibrator composed of a series of small masses with spring connections. If these masses are of atomic or molecular dimensions any ordinary impulse or impact would leave them unaffected, while vibrations of groups of them, depending on the connections, would result. But the impact on one of the masses of a hammer of sufficiently small dimensions, and mass would give vibrations depending on the structure of the mass struck, and independent of the connections, just as the bars of a xylophone ring, while the suspended series of bars, if it swings at all, does so without emitting

any audible sound. This is, I believe, in accordance with the theory now held as to X-rays. We now have some information as to the mode of producing a local excitement so intense as to cause not merely atomic disturbance, but actual disruption of the atomic structure. Further developments of Sir Ernest Rutherford's experiments and of his theory of their explanation will be eagerly awaited.

A. GRAY

ENGINEERING SCIENCE BEFORE, DURING AND AFTER THE WAR. III

THE nations which have exerted the most influence in the war have been those which have developed to the greatest extent their resources, their manufactures and their commerce. As in the war, so in the civilization of mankind. But, viewing the present trend of developments in harnessing water-power and using up the fuel resources of the world for the use and convenience of man, one can not but realize that, failing new and unexpected discoveries in science, such as the harnessing of the latent molecular and atomic energy in matter, as foreshadowed by Clerk Maxwell, Kelvin, Rutherford and others, the great position of England can not be maintained for an indefinite period. At some time more or less remote—long before the exhaustion of our coal—the population will gradually migrate to those countries where the natural sources of energy are the most abundant.

Water-power and Coal.—The amount of available water-power in the British Isles is very small as compared with the total in other countries. According to the latest estimates, the total in the British Isles is less than 1,500,000 h.p., whereas Canada alone possesses more than 20,000,000 h.p., of which more than 2,000,000 h.p. have already been harnessed. In the rest of the British Empire there are upwards of 30,000,000 h.p., and in the remainder of the world at least 150,000,000 h.p., so that England herself possesses less than 1 per cent. of the water-power of the world. Further, it has been estimated that she only possesses 2½ per cent. of the whole coal of the world. To this question I would wish to direct our attention for a few minutes.

I have said that England owes her modern greatness to the early development of her coal. Upon it she must continue to depend almost exclusively for her heat and source of power, including that required for propelling her vast mercantile marine. Nevertheless, she is using up her resources in coal much more rapidly than most other countries are consuming theirs, and long before any near approach to exhaustion is reached her richer seams will have become impoverished, and the cost of mining so much increased that, given cheap transport, it might pay her better to import coal from richer fields of almost limitless extent belonging to foreign countries, and workable at a much lower cost than her own.

Let us endeavor to arrive at some approximate estimate of the economic value of the principal sources of power. The present average value of the royalties on coal in England is about $6 per ton, but to this must be added the profit derived from mining operations after paying royalties and providing for interest on the capital expended and for its redemption as wasting capital. After consultation with several leading experts in these matters, I have come to the conclusion that about 1*s* per ton represents the pre-war market value of coal in the seams in England.

It must, however, be remembered that, in addition, coal has a considerable value as a national asset, for on it depends the prosperity of the great industrial interests of the country, which contribute a large

portion of the wealth and revenue. From this point of view the present value of unmined coal seems not to have been sufficiently appreciated in the past, and that in the future it should be better appraised at its true value to the nation.

This question may be viewed from another aspect by making a comparison of the cost of producing a given amount of electrical power from coal and from water-power. Assuming that 1 h.p. of electrical energy maintained for one year had a pre-war value of £5, and that it requires about eight tons of average coal to produce it, we arrive at the price of 6*s.* 3*d.* per ton, *i. e.*, crediting the coal with half the cost. The capital required to mine eight tons of coal a year in England is difficult to estimate, but it may be taken approximately to be £5, and the capital for plant and machinery to convert it into electricity at £10, making a total of £15. In the case of water-power the average capital cost on the above basis is £40, including water rights (though in exceptionally favored districts much lower costs are recorded).

From these figures it appears that the average capital required to produce electrical power from coal is less than half the amount that is required in the case of water-power. The running costs, however, in connection with water-power are much less than those in respect of coal. Another interesting consideration it that the cost of harnessing all water-power of the world would be about £8,000,000,000, or equal to the cost of the war to England.

Dowling has estimated the total coal of the world as more than 7 million million tons, as whether we appraise it at 1*s.* or more per ton its present and prospective value is prodigious. For instance, at 6*s.* 3*d.* per ton it amounts to nearly one hundred times the cost of the war to all the belligerents.

In some foreign countries the capital costs of mining are far below the figures I have taken, and, as coal is transportable long distances and, generally speaking, electricity is not so at present, therefore it seems probable that capital will in the immediate future flow in increasing quantity to mining operations in foreign countries rather than to the development of, at any rate the more difficult and costly, water-power schemes. When, however, capital becomes more plentiful the lower running costs of water-power will prevail, with the result that water-power will then be rapidly developed.

As to the possible new sources of power, I have already mentioned molecular energy, but there is another alternative which appears to merit attention.

Bore Hole.—In my address to Section B in 1904 I discussed the question of sinking a shaft to a depth of twelve miles, which is about ten times the depth of any shaft in existence. The estimated cost was £5,000,000, and the time required about eighty-five years.

The method of cooling the air-locks to limit the barometric pressure on the miners and other precautions were described, and the project appeared feasible. One essential factor has, however, been queried by some persons: Would the rock at the great depth crush in and destroy the shaft? Subsequent to my address I wrote to *Nature*, suggesting that the question might be tested experimentally. Professor Frank D. Adams, of McGill University, Montreal, acting on the suggestion, has since carried out exhaustive experiments, published in the *Journal of Geology* for February, 1912, showing that in limestone a depth of fifteen miles is probably practicable, and that in granite a depth of thirty miles might be reached.

Little is at present known of the earth's

interior, except by inference from a study of its surface, upturned strata, shallow shafts, the velocity of transmission of seismic disturbances, its rigidity and specific gravity, and it seems reasonable to suggest that some attempt should be made to sink a shaft as deep as may be found practicable and at some locality selected by geologists as the most likely to afford useful information.

When we consider that the estimated cost of sinking a shaft to a depth of twelve miles, at present-day prices, is not much more than the cost of one day of the war to Great Britain alone, the expense seems trivial as compared with the possible knowledge that might be gained by an investigation into this unexplored region of the earth. It might, indeed, prove of inestimable value to science, and also throw additional light on the internal constitution of the earth in relation to minerals of high specific gravity.

In Italy, at Lardarello, bore-holes have been sunk which discharge large volumes of high pressure steam, which is being utilized to generate about 10,000 h.p. by turbines. At Solfatara, near Naples, a similar project is on foot to supply power to the great works in the district. It seems, indeed, probable that in volcanic regions a very large amount of power may be, in the future, obtained directly or indirectly by boring into the earth, and that the whole subject merits the most careful consideration.

While on the subject of obtaining power, may I digress for a few moments and describe an interesting phenomenon of a somewhat converse nature, *i. e.*, that of intense pressure produced by moderate forces closing up cavities in water?

A committee was appointed by the Admiralty in 1906 to investigate the cause of the rapid erosion of the propellers of some of the ships doing arduous duties. This was the first time that the problem had been systematically considered. The committee found that the erosion was due to the intense blows struck upon the blades of the propellers by the nuclei of vacuous cavities closing up against them. Though the pressure bringing the water together was only that of the atmosphere, yet it was proved that at the nucleus 20,000 atmospheres might be produced.

The phenomenon may be described as being analogous to the well-known fact that nearly all the energy of the arm that swings it is concentrated in the tag of a whip. It was shown that when water flowed into a conical tube which had been evacuated a pressure of more than 140 tons per square inch was recorded at the apex, which was capable of eroding brass, steel, and, in time, even the hardest steel. The phenomenon may occur under some conditions in rivers and waterfalls where the velocity exceeds 50 feet per second, and it is probably as great a source of erosion as by the washing down of boulders and pebbles. Then again, when waves beat on a rocky shore, under some conditions, intense hydraulic pressures will occur, quite sufficient of themselves to crush the rock and to open out narrow fissures into caves.

Research.—The whole question of the future resources of the empire is, I venture to think, one which demands the serious attention of all men of science. It should be attacked in a comprehensive manner, and with that insistence which has been so notable in connection with the efforts of British investigators in the past. In such a task some people might suggest we need encouragement and assistance from the government of the country. Surely we have it. As many here know, a great experimental step towards the practical realization of Solomon's House as prefigured by Francis Bacon in the *New*

Atlantis is being made by the government at the present time. The inception, constitution and methods of procedure of the department, which was constituted in 1915, were fully described by Sir Frank Heath in his paper to the Royal Society of Arts last February, and it was there stated by Lord Crewe that, so far as he knew, this was the only country in which a government department of research existed.[4]

It is obvious that the work of a department of this kind must be one of gradual development with small beginnings in order that it may be sound and lasting. The work commenced by assisting a number of researches conducted by scientific and professional societies which were languishing as a result of the war, and grants were also made to the National Physical Laboratory and to the Central School of Pottery at Stoke-on-Trent. The grants for investigation and research for the year 1916–17 totalled £11,055, and for the present year are anticipated to be £93,570. The total income of the National Physical Laboratory in 1913–14 was £43,713, and, owing to the great enlargement of the laboratory, the total estimate of the Research Department for this service during the current year is £154,650.

Another important part of the work of the department has been to foster and to aid financially associations of the trades for the purpose of research. Nine of these associations are already at work; eight more are approved, and will probably be at work within the next two months; and another twelve are in the earlier stage of formation. There are also signs of great increase of research by individual factories. Whether this is due to the indirect influence of the Research Department or to a change in public opinion and a more general recognition of the importance of scientific industrial research it is difficult to say.

The possibility of the uncontrolled use on the part of a nation of the power which science has placed within its reach is so great a menace to civilization[5] that the ardent wish of all reasonable people is to possess some radical means of prevention through the establishment of some form of wide and powerful control. Has not science forged the remedy by making the world a smaller arena for the activities of civilization, by reducing distance in terms of time? Alliances and unions, which have successfully controlled and stimulated republics of heterogeneous races during the last century, will therefore have become possible on a wider and grander scale, thus uniting all civilized nations in a great league to maintain order, security and freedom for every individual and for every state and nation liberty to devote their energies to the controlling of the great forces of nature for the use and convenience of man, instead of applying them to the killing of each other.

Many of us remember the president's banner at the Manchester meeting in 1915, where science is allegorically represented by a sorrowful figure covering her eyes from the sight of the guns in the foreground. This year science is represented in her more joyful mien, encouraging the arts and industries. It is to be sincerely hoped that the future will justify our present optimism.

CHARLES A. PARSONS

[4] The Italian government are now establishing a National Council for Research, and a bill is before the French Chamber for the establishment of a National Office of Scientific, Industrial and Agricultural Research and Inventions.

[5] For instance, it might some day be discovered how to liberate instantaneously the energy in radium, and radium contains 2,500,000 times the energy of the same weight of T.N.T.

CYRIL G. HOPKINS

DR. CYRIL G. HOPKINS, head of the department of agronomy of the University of Illinois, passed away at the British Military Hospital at Gibraltar, on October 6, of congestion of the brain with malarial complications.

He had finished a year's work in the study of the exhausted soils of Greece under the auspices of the American Red Cross, had made his official report, had seen to the preparation of a Greek translation, had been decorated by the King of Greece "for distinguished service," and had taken ship for home when, without warning, the third day out from Gibraltar, the fatal illness struck him and at the age of fifty-three at the very zenith of his powers, his service was brought to an end. Just what that service was, I shall attempt to state as clearly as it is possible for a layman to state it.

Dr. Hopkins was a chemist both by training and by instinct. He had the chemist's conception that everything about us is built up of well-known elements in varying but definite proportions. He carried this conception into crops and into the study of soils which provides certain of the necessary elements in crop production. He was keenly impressed with the fact that most crops are produced out of the natural store of plant food just as coal is produced from the mines without restoration, and that this being the case, the individual can not compete against an agriculture which mostly draws upon virgin stores if he undertakes to apply to his land anything more than what is necessary to increase the amount "of the limiting element." By this, he meant the particular form of plant food which chances to be lacking and, therefore, which limited the combinations which might be made in the form of plants. He announced the doctrine that the farmer should first know his soil by an inventory of its constituents, particularly those likely to run short as a merchant takes frequent inventory of his stock and places timely orders where the stock is running short, leaving the full shelves alone until they shall begin to run low.

With this view of the situation, he made scientific objections to the whole theory of prepared mixed fertilizers just as he did to the idea of a patent medicine, believing with the physician that the first step is to diagnose the situation and then to find the particular remedy that is needed and apply it. He particularly objected to the use of "acid phosphates" partly because of cost arising from the fact that a full half of the weight consisted of sulphuric acid which is not a fertilizer and partly because of the fact that the acidity of soils, even under normal conditions needs frequent correction in order that the bacteria may thrive upon the roots of legumes and the store of nitrogen be properly increased.

Again with this conception of maintaining fertility, Dr. Hopkins believed, and his experiments seemed to confirm the belief, that sufficient amounts of nitrogen for ordinary farming purposes could be obtained by proper rotation of crops introducing the legumes with reasonable frequency, provided that soils were not allowed to become acid and that suitable measures were taken to promote bacterial growth.

The great slogan which Dr. Hopkins constantly employed was that of a "Permanent Agriculture," by which he meant that in the application of fertility, regard should be had, not only for the immediate results, but for the permanent effect upon the land, the test of which lay in this question: *"Am I applying in my fertilizers as much phosphorus or potassium as I am removing in my crops and am I abstracting from the atmosphere by my rotations enough nitrogen to restore the draft upon the land?"* He insisted that every farmer should not only be able to answer this question in the affirmative, but that if he chose for application the cheapest sources of plant food, he would be able to apply a little more year by year than he took out.

For this reason, the system which Dr. Hopkins advocated was the application of enough fertilizer to replace what would be taken out by a hundred bushels of corn, fifty bushels of wheat and so on for the other maximum yields. In this way, he argued—and seemed fully able to prove—that the American farmer

could build up an agriculture that would be not only profitable but also permanent and increasingly productive.

E. DAVENPORT

SCIENTIFIC EVENTS

ATOMIC ENERGY

AT the second day of the James Watt centenary commemoration at Birmingham those present heard an address by Sir Oliver Lodge foreshadowing the possible employment of atomic energy.

According to the report in the London *Times* Sir Oliver Lodge said that, in view of the fact that the sources of molecular energy are beginning to show signs of exhaustion, he ventured to assume that if James Watt were living to-day he would be directing his attention to discovering whether there are other stores of energy at present almost unsuspected. The fact was that contained in the properties of matter there was an immense source of energy so far inaccessible, but which he saw no reason why the progress of discovery should not make available. He referred to atomic energy which, if it could be utilized on an extensive scale, would, he believed, greatly ameliorate the conditions of factory life. There would be no smoke due to imperfect combustion and no dirt due to the transit of coal or ashes, while the power would be very compact and clean. Possibly there might occasionally be explosions due to the liberation of power more quickly than it was wanted, but in general he presumed that the conditions of utilization would be good.

Sir Oliver explained that the secret of this power began to be given away when radio-activity was discovered, and said that at present we were hardly at the beginning of its utilization. The discovery of radium, which soon followed, excited universal interest and aroused great surprise, because radium appeared to give off energy continually without being consumed. The truth was that it did disappear as it gave off its energy, but the disappearance was so slow and the energy given off so remarkable that it was not surprising that one was noticed before the other. The energy of radium, however, was not under control, and it went on emitting energy at its own proper rate without regard to accidental circumstances. What happened was that every now and then a particle was projected. The energy stored in an atom was something enormous, and if we could make the atoms fly off when we wanted there would be available a source of energy which would put everything else into the background. This energy was contained in all forms of mater and was not confined to radio-active substances. If a stimulus could be found the utilization of this source of energy would be possible. We appeared to be on the verge of utilizing a minute fraction of it, and it was this energy which had made wireless telephony possible.

STATISTICS OF THE NATURAL GAS INDUSTRY

A REPORT on "Natural Gas and Natural Gasoline in 1917" by John D. Northrop, just published by the Geological Survey, gives statistics of the production and consumption of natural gas and sketches the condition of the industry in 25 states. It gives also statistics concerning gasoline made from natural gas in that year.

More than 2,100 cities and towns in the United States are supplied with natural gas, which is furnished to domestic consumers at rates that should arouse the envy of those consumers of artificial gas who have to pay about a dollar a thousand cubic feet. The average price per thousand cubic feet charged to consumers of natural gas in the United States in 1917 was about 30 cents. The average price charged to manufacturers was less than 12 cents.

Most of the towns and cities supplied with natural gas are in New York Pennsylvania, Ohio, West Virginia, Kansas, Oklahoma and California. In Ohio 872,000 domestic consumers were supplied in 1917, In Pennsylvania 480,000, in California 239,000, in Kansas 188,000, in New York 164,000, in West Virginia 129,000, and in Oklahoma 95,000. The industrial consumers, by whom the gas is used for manufactures or for generating power, use twice as much gas as the domestic users.

The recovery of gasoline from natural gas has now become a large industry, which contributes materially to the supply of motor fuels. Experiments in the conversion of natural gas to gasoline were made as early as 1903, but experiment did not give way to commercial production until about 1910. The growth of the industry since that year has been remarkable. In 1911 there were in operation 176 plants, which produced about 7,400,000 gallons of raw gasoline from natural gas. In 1917, only six years later, there were 886 plants, which produced nearly 218,000,000 gallons. Prior to 1916 most of the gasoline recovered from natural gas was derived from casing-head gas obtained from oil wells, by methods involving compression and condensation, but from year to year an increasingly large proportion of the annual output of natural-gas gasoline has been recovered by the absorption process, which has now been applied not only to "wet" gas from oil wells but also to so-called "dry" gas, which occurs independent of oil and constitutes the main supply of natural gas. Dry gas can not be profitably converted into gasoline by compression.

LEATHER FROM AQUATIC ANIMALS

THE Bureau of Fisheries reports that excellent progress in the tanning of fish leather is to be recorded, and a number of the difficulties that have retarded the development of the industry have been overcome by tanners in this field.

One company which is tanning fish-skins has established a station in North Carolina and another in Florida for the capture of sharks and porpoises, and is meeting with success in its fishery for sharks. It is understood that the number of stations will be increased as rapidly as possible. Another company which has recently acquired a site for a tannery in Washington plans to tan the hides of sharks, beluga, hair seals, etc.

Samples of leather recently submitted show marked improvement in appearance over earlier samples. The leather is soft and pliable and appears to have ample strength for many uses. Arrangements have been perfected for the Bureau of Standards to make tests of later products as to durability, porosity, tensile strength, pliability, water absorption, wearing qualities, etc.

The nets which the Bureau developed for the capture of sharks are proving successful and are being adopted for the fishery. At the fishery stations the liver oil is extracted and the flesh is converted into fertilizer, so that none of the material is wasted.

The supplies of walrus leather, which is cut into wheels and used for polishing fine metal surfaces or for removing mars and scratches on bright metal objects, have heretofore been imported. Last year the bureau furnished several interested persons with pieces of walrus hides for tanning and has recently received a sample of leather made therefrom for which tests are being arranged to determine its suitability for such purposes.

VACATION NATURE STUDY

BELIEVING that a better knowledge of wild life will bring about better conservation of it, and that when people are on their summer vacations they are most responsive to education on wild life resources, the California Fish and Game Commission backed by the California Nature Study League instituted this past summer a series of lectures and nature study field trips designed to stimulate interest in the proper conservation of natural resources. Six different resorts in the Tahoe region were selected for the work, and here illustrated lectures on the game birds, song birds, mammals and fish, given by Dr. Harold C. Bryant, of the University of California, furnished evening entertainment and early morning trips afield gave visitors an introduction to mountain wild life.

The motto of the field classes was: "Learn to read a roadside as one reads a book." Special excursions for children gave surprising results owing to the rapidity with which they absorbed information about the living things encountered.

Compact nature study libraries were placed at the resorts by the California Nature Study League and an exhibit of colored pictures and other illustrated material was on display.

Thus visitors were further able to increase their fund of information regarding wild life by a study of pictures giving full colors, by specimens and by books giving detailed facts.

This experiment in making conservationists out of "vacationists" proved so successful that another year will doubtless see the work expanded and the opportunity to study under a nature guide offered to thousands of those on their holidays in all parts of the state.

A COMPENDIUM OF CHEMICAL AND PHYSICAL CONSTANTS[1]

Science played so important a rôle in the war that one of the war's outcomes has been a national stock-taking by each of the principal countries engaged in the struggle of its condition, both as regards the scientific knowledge and resources already in its possession and the means it has for increasing this knowledge. England, Japan and America have all established departments or councils of national scientific research, either supported by government, as in the case of England and Japan, or by private funds, as in the case of our own National Research Council.

Out of this stock-taking has come the realization that certain scientific knowledge and the means of access to it have been largely in the hands of the Germans, and that other countries have been obliged to rely on German publications in order to make any use of it at all. A notable instance of this is afforded by the situation as regards the chemical and physical constants so indispensable for precise work in all chemistry and physics and in the application of these sciences to industry.

The National Research Council, therefore, with the cooperation of the American Chemical Society and the American Physical Society has planned to compile and issue a critical American compendium of chemical and physical constants which shall be up to date and correct, which, by the way, the German publications were not. And yet these badly organized and inaccurate German compendia were the only ones available to the American experts during the war in connection with their all-important scientific work on the pressing problems of war technique.

[1] Press bulletin issued by the National Research Council.

This will be a tremendous task and will involve the expenditure of at least $100,000 which must be obtained from private sources. The committee representing the National Research Council and the American Chemical and Physical Societies will have to scour all the university and research laboratories of the country for the needed facts. In addition the committee will attempt to find out from the business and industrial concerns of the country whose work is based on applied chemistry and physics a list of all the constants required in their work, and then will undertake to have these determined by scientific investigators and included in the compendium. A successful outcome of this large undertaking will be of inestimable value to the scientific and material strength of the nation.

SCIENTIFIC NOTES AND NEWS

At the October meeting of the executive board of the National Research Council Professor Vernon Kellogg, of Stanford University, was elected executive secretary of the council. He will hold this position in addition to that of chairman of the council's division of educational relations which he assumed last July. Professor Kellogg's work with Mr. Hoover's relief organizations and the Food Administration, which extended from May, 1915, to the present, is now practically at an end, although he remains one of the directors of the American Relief Administration European Children's Fund, which is the one still active organization under Mr. Hoover's direction.

At its meeting held on October 8, the Rumford Committee of the American Academy of Arts and Sciences voted the following appropriations: To Professor Frances G. Wick, of Vassar College, in aid of her researches on the phosphorescence of hexagonite and of fluorite at ordinary and low temperatures, $300; to Professor Robert W. Wood, of the Johns Hop-

kins University, for the continuation of his optical investigations, additional to former appropriations, $350.

Dr. Theobald Smith, director of the department of animal pathology of the Rockefeller Institute for Medical Research, formerly professor of comparative pathology at Harvard University, has been appointed Cutter lecturer on preventive medicine and hygiene at Harvard University for the next academic year.

The Botanical Society of Washington has elected the following officers for the ensuing year: *President,* Haven Metcalf; *Vice-president,* A. J. Pieters; *Recording Secretary,* Chas. E. Chambliss; *Corresponding Secretary,* R. Kent Beattie; *Treasurer,* L. L. Harter.

Professor H. von Mangoldt has been elected president of the German Mathematical Society, and Professor Felix Klein, honorary president.

Dr. John E. Teeple, of New York City, has been elected treasurer of the American Chemical Society to fill the unexpired term of the late Dr. E. G. Love.

After many years of service in the examination of applications for chemical patents, Mr. Bert Russell has resigned his position as first assistant examiner, to devote his attention largely to chemico-legal problems arising in the patent practise of Messrs. Prindle, Wright and Small, of New York City. Mr. Russell has been secretary of the Patent Office Society, which has been active in improving the resources, the standards and the efficiency of the Patent Office.

Dr. Carl Hartley, pathologist in the office of forest pathology, Bureau of Plant Industry, has recently resigned to accept a position as pathologist with the Instituut voor plantenziekten en Cultures, Buitenzorg, Java.

Dr. L. C. Glenn, who has recently been on leave of absence from Vanderbilt University while in charge of the collection of oil and gas valuation data in Kentucky, Tennessee and Alabama for the Internal Revenue Department, has made an examination for the United States Department of Justice of certain oil lands along the Red River near Burk-Burnett, Texas, over which there has arisen a question as to jurisdiction between Texas and Oklahoma.

Professor Merle Randall, of the department of chemistry of the University of California, has returned to Berkeley after having spent the summer as research chemist in the laboratories of the Experimental Kelp-Potash Plant of the U. S. Department of Agriculture, at Summerland, California.

Professor Henry B. Ward, of the University of Illinois, special assistant of the Bureau of Fisheries, has returned to Urbana, after completing an investigation of the salmon spawning grounds of the Copper River and certain important tributaries. Accompanied by Professor W. A. Oldfather, also of the University of Illinois, and J. R. Russell, superintendent of the Bureau's fish-cultural stations in Washington.

Professors R. A. Daly, of Harvard University, and A. G. Mayor, of Princeton University, have returned from an expedition to American Samoa under the auspices of the Department of Marine Biology of the Carnegie Institution of Washington. Professor Daly made a study of the lithology of Samoa, and also confirms the opinion that the fringing reef now surrounding Tutuila is of recent origin, and was antedated by a time wherein there were no living reefs around the island. Ancient reefs are sunken to depths of about 30 fathoms, but these have nothing to do with the modern reefs. Corals were planted out at depths between 8½ fathoms and the surface in order to determine the growth-rate of the reefs.

At the eight hundred and twenty-first meeting of the Philosophical Society of Washington which was held on Saturday, October 11, Dr. C. G. Abbott read a paper on "Solar studies in South America"; Dr. L. A Bauer, on "The total solar eclipse at Cape Palmas, Liberia, May 29, 1919," and D. M. Wise, on "The total solar eclipse at Sobral, Brazil, May 29, 1919."

The Bulletin of the American Mathematical Society states that the firm of Julius Springer,

Berlin, announces the publication of a new journal devoted exclusively to original mathematical memoirs, the *Mathematische Zeitschrift*. It is edited by Professor L. Lichtenstein, with the collaboration of Professors K. Knopp, E. Schmidt and I. Schur and an editorial committee consisting of Professors W. Blaschke, L. Féjer, C. Herglotz, A. Kneser, E. Landau, O. Perron, F. Schur, E. Study and H. Weyl. Two volumes appear annually.

Dr. Edward L. Thorndike, professor of educational psychology in Teachers College, Columbia University, delivered an address at Wesleyan University on October 14 on "Psychological tests for college entrance examinations."

Dr. Alexander D. Blackader, professor of pharmacology and therapeutics in McGill University, Montreal, delivered the annual address to the medical students on Founder's Day, his subject being, "Our medical faculty and the value of continued medical research."

The late Professor Rudolf A. Witthaus, of the Cornell Medical College, bequeathed his medical apparatus and scientific books to the college.

Wilhelm von Siemens, head of the Siemens-Halske Companies, is dead at Arona, Switzerland.

Nature reports that the council of the Royal Society has nominated representative committees to deal with national questions connected with the international unions which it is intended to form under the International Research Council. The committee for astronomy will consist of the Astronomers Royal for England, Scotland and Ireland, the Superintendent of the Nautical Almanac, six members nominated by the Royal Society, six members nominated by the Royal Astronomical Society, two members nominated by the Royal Society of Edinburgh, two members appointed by the Royal Irish Academy and two members appointed by the British Astronomical Association. The committee for geodesy and geophysics will consist of the Astronomers Royal, the director of the Meteorological Office, the director-general of the Ordnance Survey, the hydrographer of the Navy, two representatives of the Royal Society of Edinburgh, two representatives of the Royal Irish Academy, two members nominated by the British Association, and two members nominated by the Royal Society. Since their formation these committees have advised the council of the Royal Society on the formation of the international unions in their respective subjects, and nominated the delegates to the recent meeting at Brussels. The Federated Council for Pure and Applied Chemistry was also recognized as the national committee on that subject.

The following lectures were delivered during the graduate summer quarter in medical sciences at the University of Illinois, College of Medicine, Chicago, Illinois.

"Transmission of eye-defects induced in rabbits by means of lens-sensitized fowl-serum:" Michael F. Guyer, Ph.D., professor of zoology, at the University of Wisconsin.

"Metabolic gradients:" C. M. Child, Ph.D., professor of zoology at the University of Chicago.

"Modes and age periods of infection in tuberculosis:" M. P. Ravenel, M.D., professor of preventive medicine at the University of Missouri.

"Catalase:" W. E. Burge, Ph.D., assistant professor of physiology at the University of Illinois.

"Nerve transplantation:" C. Carl Huber, M.D., professor of anatomy at the University of Michigan.

"Malaria with especial reference to its control:" C. C. Bass, M.D., professor of experimental medicine, Tulane University.

"Giant cells and their rôle in bone resorption:" Leslie B. Arey, Ph.D., professor of microscopic anatomy, Northwestern University., Medical School.

"The influence of some chemical substances on immunity reactions:" Aaron Arkin, Ph.D., M.D., professor of pathology and bacteriology, University of West Virginia.

The Advisory Committee of the American Chemical Society, on the authority given it by the council, has recommended Professor W. A. Noyes as chairman of the board of editors in charge of the scientific series of monographs, and Dr. John Johnston as chairman of the board of editors of the technological series of monographs recommended by the committee

The Royal Society announces that two John Foulerton studentships will shortly be awarded for original research in medicine, the improvement of the treatment of disease, and the relief of human suffering. Researches must be carried out under the supervision and control of the Royal Society. The studentships are of the value of £400 each, and are tenable for three years, but may be extended to a total period of six years. Candidates must be of proved British nationality; both sexes are eligible.

UNIVERSITY AND EDUCATIONAL NEWS

At a recent meeting of the New York Endowment Fund Committee of the Massachusetts Institute of Technology, Mr. Coleman du Pont presiding, President R. C. MacLaurin announced that $1,500,000 had been subscribed toward the $8,000,000 endowment fund. "Mr. Smith," the anonymous donor of $7,000,000 to the institute, has agreed to give $4,000,000 to the fund if $3,000,000 is pledged by January 1, 1920.

Dr. George W. Crile, of the School of Medicine of Western Reserve University, has given $100,000 to endow a chair of surgery. Dr. Crile is chief of the surgical staff of the school. He headed the Lakeside Hospital Unit of Cleveland, one of the first American units in France.

Columbia University has received a gift of $6,000 for research work in food chemistry.

Professor Samuel N. Spring has returned to the United States for the first term of the present college year to teach silviculture, forest law and policy in the Department of Forestry at the University of Missouri. He will resume his work as professor of silviculture at Cornell University on January 1, being at present on leave of absence.

Richard M. Field has been appointed assistant professor of paleontology and historical geology at Brown University. He also continues his association with the research staff of the Museum of Comparative Zoology at Cambridge.

Edward H. Mack, Ph.D. (Princeton, 1916), has returned from overseas duty and has gone to the Ohio State University as assistant professor of physical chemistry.

Professor Edwin Morrison, for thirteen years head of the department of physics at Earlham College, has been granted a year's leave of absence and is teaching engineering physics in the Michigan Agricultural College.

C. M. Young, formerly of the University of Kansas, has returned as professor and head of the department of mining engineering.

Dr. Horst Oertel has been appointed head of the department of pathology at McGill University.

Dr. Edward Hindle, Kingsley lecturer and fellow of Magdalene College, Cambridge, assistant to the Quick Professor of biology, has been elected to the chair of biology in the School of Medicine, at Cairo, Egypt, in succession to professor A. Looss. Dr. Hindle was instructor in zoology at the University of California from 1909 to 1910.

DISCUSSION AND CORRESPONDENCE

DOUBLE USE OF THE TERM ACCELERATION

To the Editor of Science: The use of clear and distinct meanings of terms has not kept pace with the progress in science. One repeatedly hears appeals for the stardardization of the meanings of terms. Great confusion arises when different writers use the same term with entirely different meanings. In the writer's opinion, it is quite as important to fix the definitions of the fundamental terms as it is to fix the units; scientific organizations ought to get together, arrive at some conclusion, and then appeal to the Bureau of Standards to officially standardize such definitions as they do the units.

A notable case which gives rise to much confusion, is the term acceleration. The engineer always used this term to mean the rate of increase of speed, that is, velocity divided by time, hence its dimensions are LT^{-2}; it is measured in feet (or meters) per

second per second. The physicists, however, who use this term in the same sense, also use it indiscriminately in an entirely different sense, namely, to express a change of direction of a moving body, without any regard as to whether there is any change in speed or not. Thus the physicist will refer to the existence of acceleration when to the engineer there is none. A case in point is the revolution of a fly wheel at a constant speed, the rim of which to the physicist is being constantly accelerated while to the engineer there is no acceleration, as the speed is constant.

The physicist argues, and quite correctly, that a moving body represents a vector quantity, as it has both speed and direction. The same external force applied to such a moving body will change either the speed or the direction, depending upon the relative directions of that force and of the moving body. But as force is defined as mass $\times$ acceleration, the physicist, apparently forgetting the difference between pure and applied mathematics, methodically divides this force by the mass and calls the quotient acceleration. It simplifies his mathematics.

Such blind applications of pure mathematics, however, sometimes lead to absurd results. In the present case, if this external force is applied in the direction of the movement of the body, it adds energy to the moving system, as in the case of a falling body. This is the sense in which engineers use the term acceleration. But if this external force is applied perpendicularly to the direction of motion, no energy whatever is added to the moving system, as in the case of bodies rotating around a center.

The importance of this distinction is shown in the common term foot-pounds, the product of feet and pounds (of force). If both are in the same direction this product represents energy, while if perpendicular to each other it represents torque, which is decidedly not energy. The writer long ago suggested to use the term pound-feet, when it refers to torque, in order to call attention to the difference.

In the MLT system of dimension of physical quantities, force multiplied by length gives energy; hence torque has the dimension of energy, when as a fact they are two entirely different physical quantities. The reason for this inconsistency is that in this system an angle has no dimension, yet we know that torque (which is not energy) when multiplied by an angle gives energy, hence an angle must have some dimensions. This is one of the serious shortcomings of that system. It is also the cause of the double use of the term acceleration.

When force is defined as mass $\times$ acceleration, it should be understood that the angle is eliminated by being zero; acceleraton is then always a change of speed, the sense in which the engineer uses that term. A new term should be used when the force is at right angles to the direction of motion, in which case it adds no energy to the system and produces no change in speed, but merely a change of direction. For any angle between 0 and 90° no further distinction is required as the resultant then is always the vector sum of the two components at 0 and 90°.

Such a distinction between these two different meanings of acceleration is very desirable in order that the engineer and the physicist may always understand each other without confusion.

Carl Hering

Philadelphia,
October 7, 1919

AN ORNITHOMIMID DINOSAUR IN THE POTOMAC OF MARYLAND

A recent study of some of the dinosaur specimens in the United States National Museum from the Arundel formation of Maryland has led to a discovery of more than ordinary interest. It is the recognition of an undoubted Ornithomimid dinosaur, the first representative of this group to be found east of the Rocky Mountain States, or geologically below the Judith River formation of the Upper Cretaceous.

The materials on which this determination rests consist of various bones of the hind foot, pertaining to more than one individual. Originally some of these elements were in-

cluded among the cotypes on which Marsh[1] founded the species *Allosaurus medius,* but in 1911 they were removed from the Theropoda by Lull[2] to the Ornithopoda, and with other bones made the cotypes of the new species *Dryosaurus grandis.* I had never been satisfied in my own mind that these bones pertained to a herbivorous dinosaur but it was only recently that I have had the opportunity of comparing them with Ornithomimid materials. Through the courtesy of Mr. Walter Granger, of the American Museum of Natural History, I was enabled to compare these foot bones with those of the genotype of *Struthomimus altus* (Lambe) and other Ornithomimid foot materials from the Belly River and Edmonton formations, and in every instance have found such close resemblances as to leave no doubt of their Ornithomimid affinities, a view concurred in by Mr. Barnum Brown, of the above institution.

In an extended paper on the carnivorous Dinosauria contained in the collections of the U. S. National Museum, now in press, these bones are discussed in detail and are there tentatively assigned to the genus *Ornithomimus.*

The recognition of this Ornithomimid dinosaur led to an investigation of the other members of the Arundel fauna and the preliminary study appears to show that there are at least three other dinosaurian forms having Upper Cretaceous affinities.

The presence of dinosaurs with Upper Cretaceous affinities, associated with Sauropod dinosaurs (*Pleurocœlus*) is a combination previously unknown, but whether it means that the Sauropoda lived on to a much later time than we had previously suspected or whether we have in these dinosaurs of Upper Cretaceous affinities the progenitors of the Judith River (Belly River) forms, I shall reserve judgment until a critical study of the whole fauna, now in preparation, is completed.

The Arundel formation is regarded by the most competent authorities to be Lower Cretaceous in age, and equally eminent paleontologists have correlated the Arundel fauna with the Morrison fauna of the Rocky Mountain region so that the conflicting evidence of these later discoveries promises to be of both paleontological and geological interest.

Charles W. Gilmore

U. S. National Museum,
October 4, 1919

[1] *Amer. Jour. of Sci.* (III.), Vol. XXXV., 1888, p. 93.

[2] Geol. Survey of Maryland, Lower Cretaceous, 1911, pp. 204–206, Fig. 7; Pl. 20, Figs. 1–4.

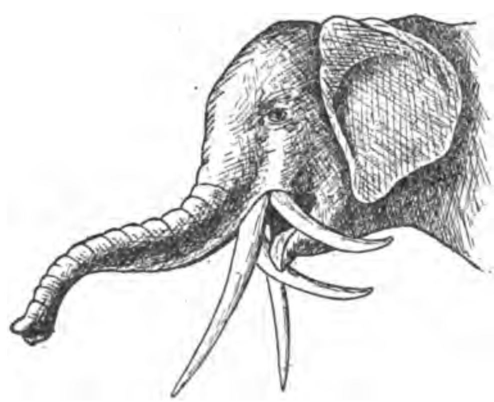
AN ELEPHANT WITH FOUR TUSKS

To the Editor of Science: I have thought that the accompanying note with regard to the "elephant with four tusks," and its illustration would be interesting for Science to reproduce as an extraordinary record tucked away in a rather remote publication.

Picture and text are taken from "Sudan Notes and Records," Volume 2, number 3, July, 1919, page 231, and the account is there printed in Arabic with the accompanying translation. I am sure this will engage the attention of our many mammalogists and paleontologists.

John M. Clarke

On the 18th May, 1917, I went out shooting in the district of Sheikh Ako Mangara, in the Markaz of Yambio, in the village of Wakila Marbo, on the borders between Tembura and Yambio districts.



I met a herd of elephant which I followed, searching for a good one to shoot. I kept following them until they stopped near a pool of water, where they began to drink and throw mud on them-

selves. I was in hiding behind a tree about fifteen yards from them looking at them, when I saw an elephant with four tusks as roughly represented in the attached sketch.

The left tusk was the bigger and had the usual direction, but the direction of the small tusk was downwards and came out from under the big one. It was round, and its thickness was about 2½ inches.

The direction of the right tusk was downwards and the small tusk came out from under it in the usual direction, but it was small like the other one.

I did not know that this elephant was so valuable and for this reason I did not try to shoot it, although the Ombashi and the soldier who were with me told me to shoot it, but I refused. This is all the story.

Abd El-Farag Ali, M.A.

Yambio,
February 17, 1919

QUOTATIONS

THE WORK OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Your leading article of this morning expresses some dissatisfaction which even those who have best cause to be satisfied with the recent meeting will readily share. You sneer at the "vast sum" of £1,300 provided for research at the outcome of the meeting. We all share your obvious wish that it were much larger, and the treasurer especially made that desire clear at one of the evening meetings. Any hint you may give us how it may be increased will be gratefully received. Meanwhile it is possible that its exact significance is not fully understood. It represents, so to speak, the extra charges for heating and lighting when a big factory is run overtime by voluntary workers. The main expenses of the scientific organization of the country, including the salaries of professors and demonstrators, are met in quite other ways. Some members of ths large staff find that they have time and energy to work overtme—to conduct some research which has occurred to them as desirable if only a piece of apparatus can be provided or the expenses of a series of computations met. They ask for no addition to their salaries for this work, though such additions could in many cases be reasonably defended. They come to the British Association only for out-of-pocket expenses. The value of the work thus done is enormous, and if fully remunerated would represent a sum many times greater than that actually devoted to it.

It follows that there is a limit to possible expenditure of this kind. I do not mean to suggest that has been reached, but clearly the unpaid overtime obtained from a given staff has its limits. There comes a point at which more work can be got only by adding to the staff, and at this point the British Association generally hands over the matter to some other body. Thus the beginnings of our Great National Physical Laboratory, now added to the scientific resources of the nation, may be traced in the earnest but unassuming work done by the British Association many years ago when in your own words "some of the best brains in Great Britain met in solemn conclave to allot the vast sum" of about £1,000, only a fraction of which could be devoted to the fundamental work of fixing accurately the electrical and other standards. The war has accustomed us to the huge sums which are apparently available for destruction: it is a commonplace that the beginnings of the most important constructive work are usually small. Is your sneer altogether appropriate?

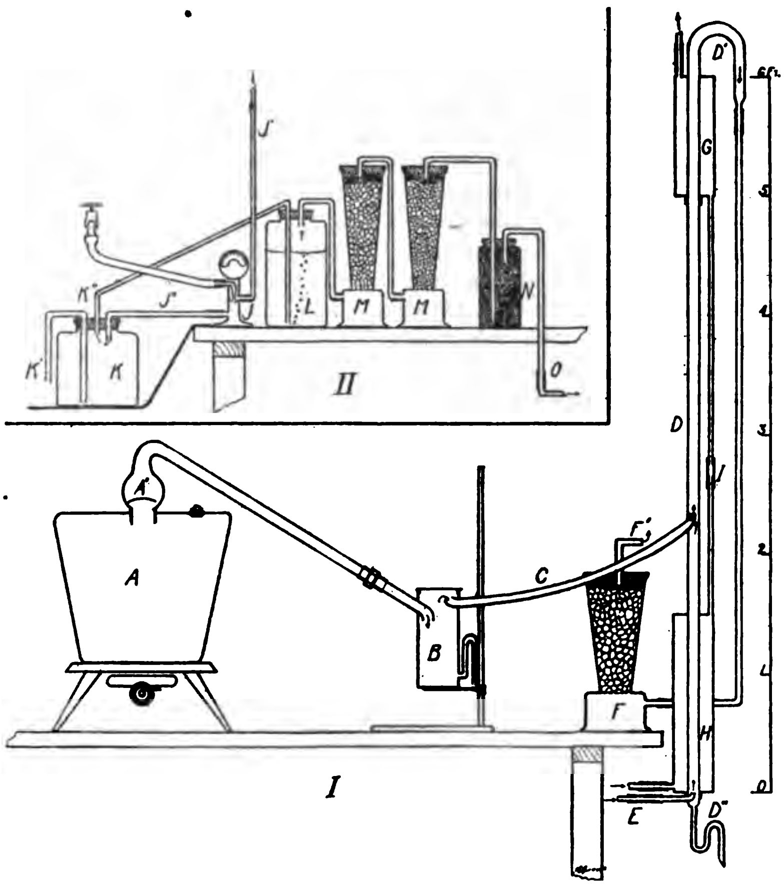
With your suggestions that the camp followers should be dismissed and the discussions specially directed to the "technical methods on which the progress of science depends" I do not find myself altogether in sympathy. We owe much to the camp followers, even beyond the money they provide for research; and the experts can meet at the Royal Society for technical discussions. But I scarcely know whether you would welcome a reconsideration of the declared objects of the British Association in your columns: at any rate, I hesitate to enter on so large a field without some indication of permission. On the point you consider most vital, that the Association should "insist on the advancement of science simply as knowledge, and not merely as a means to practical utilities," we are all fully agreed, as a glance

at the most vital procedure—viz., the allotment of grants—will sufficiently indicate. If some of the accessories have a different appearance, surely allowance may be made for the disturbance caused by the greatest war in history?—H. H. Turner, General Secretary of the British Association, in the London *Times*.

SPECIAL ARTICLES

THE BOURDILLON WATER STILL

THOSE who wish to obtain an abundant supply of "conductivity" water may be interested in a distilling apparatus which has been in use in this and other departments of the University of Wisconsin for the past few years. This still was originally described by



EXPLANATION OF FIGURES

FIG. 1. Steam Generator and Boiler. *A*, boiler, 15-liter capacity, copper; *A'*, dash plate; *B*, trap with removable lid, copper; *C*, lead to condenser, ½-inch diameter, block tin; *D*, condenser-tube, 6 feet long, 1 inch inside diameter, block tin; *D'*, outlet for escaping gases, block tin; *D''*, outlet for condensed water, block tin; *E*, inlet for washed air, block tin; F, soda-lime tower and H_2SO_4 in pumice tower (the figure shows but one jar); *F'*, outlet to out-of-doors; *G*, upper condenser jacket, 12 inches long, 4 inches diameter, copper; *H*, lower condenser jacket, 18 inches long, 4 inches diameter, copper; *I*, rubber connection serving as expansion joint.

FIG. 2. Air Pump and Wash Train *J*, aspirator; *J'*, air inlet from out-of-doors; *J''*, water and air outlet of aspirator sealed into top of jar; *K*, pressure jar; *K'*, water outlet of pressure jar *K*; *K''*, air outlet of pressure jar *K*; *L*, wash jar containing commercial H_2SO_4; *M,M*, soda-lime towers; *N*, dust filter of cotton-wool; *O*, washed air outlet connecting with *E* of Fig. 1.

Bourdillon.[1] It was first used in this university by Mr. M. Meacham in 1914–15 in the laboratory of Dr. S. F. Acree. With this apparatus slightly modified from the original the writers have been able to secure a very good grade of water by a single distillation of laboratory tap water.

Referring to the accompanying illustration, Fig. 1 consists of a boiler and condenser and Fig. 2 of an air-washing apparatus. The essential feature of the operation of the still is the washing with a stream of purified air of steam and of hot condensed water while spread out over the large interior surface of the consenser-tube. During operation the steam passes from the boiler *A* (Fig. 1) through the trap *B* and upward through the condenser-tube *D*. At the upper end of *D* it is condensed and runs while still hot down the sides of *D* to the bottom where it is further cooled before being discharged into the receiving vessel. During the passage through D the steam and hot water are washed by a stream of purified air which is forced into *D* at the bottom and passes upward and out at the top carrying with it volatile impurities from the steam and hot water. The nonvolatile impurities are retained in the boiler.

It is usual to put about one gram of $KHSO_4$ or H_3PO_4 into the boiler for each two or three liters of water, although this may not be essential. In the construction of the condenser it is better to have the workman use muriatic acid rather than rosin as a flux for soldering, because the latter substance may be difficult to remove from the interior after completion. In the arrangement of the air-washing system it is essential to have the soda-lime towers between the acid jar and the condenser to prevent any volatile fumes from the acid passing into the condenser. It is better that air be forced rather than drawn through the apparatus, because this avoids the possibility of contaminating the air stream by leakage of laboratory gases inward. The air pressure obtained from the pump may be regulated by varying the height of the water outlet *K′* as well as by regulating the water supply to the aspirator. Contamination of the interior of the condenser tube *D* from the outside is prevented by inserting absorbing chambers *F* of soda-lime and H_2SO_4 in pumice between *D′* and the out-of-door outlet *F′*.

[1] *Trans. Chem. Soc.*, 103, 791, 1913.

By using special care and after continued use for some time, water with a specific conductivity of 0.4×10^{-6} mhos has been obtained from tap water by a single distillation. With a fifteen-liter boiler on an ordinary gas-range burner, no difficulty has been encountered in securing eight to ten liters of water per day having a specific conductivity of from 1 to 2×10^{-6} mhos. After the apparatus has been started and regulated, it requires very little attention. The following data are offered as an example of what may ordinarily be expected of this still.

TABLE I

Specific Conductivity of Water Obtained from Tap Water by a Single Distillation with Potassium Acid Sulphate and Phosphoric Acid

$KHSO_4$ Added to Water in Boiler		H_3PO_4 Added to Water in Boiler	
Samp. No.	Conductivity $\times 10^{-6}$	Samp. No.	Conductivity $\times 10^{-6}$
1	1.05	7	1.15
2	1.01	8	0.97
3	1.30	9	1.01
4	0.68	10	0.89
5	0.94	11	1.91
6	0.89	12	0.89
Average	0.94	Average	1.14

J. P. BENNETT
JAMES G. DICKSON

BOTANY DEPARTMENT,
UNIVERSITY OF WISCONSIN

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GEOPHYSICS AT THE BRUSSELS MEETINGS, JULY 18–28, 1919[1]

Under the auspices of the International Research Council, which met at Brussels in the Palais des Académies, July 18–28, 1919, there was established, besides other international unions of astronomy, mathematics, physics, chemistry, biology, scientific radiotelegraphy, etc., the International Geodetic and Geophysical Union, consisting of the following sections and officers:

Since there were represented at Brussels this time only the countries of the Allies, it was concluded to defer complete organization of the sections until the entrance into the Union of other countries to be invited by the International Research Council. In the case of Section (*b*) (Seismology), since the agreement among nations belonging to the International Seismological Association, formed before the war, does not expire until April 1, 1920, it was necessary to postpone any organization, whatsoever, of the section. However, as the central office of the association is at Strasburg, it is fitting that it continue there when the Section of Seismology is organized. Professor E. Rothé has been appointed to the chair of geophysics, at the University of Strasburg, France. The rector of the university invited the delegates at Brussels to attend the opening, on November 11, 1919, of the university, now under French auspices.

The *Executive Committees of the Sections* were for the present limited to the president, vice-president and secretary, excepting in the case of (*e*) (Physical Oceanography) where Sir Charles Close (British Ordnance Survey)

[1] Basis of an account which the writer was requested to give before the combined meeting at Ann Arbor, September 4, 1919, of the American Astronomical Society, American Mathematical Society, and the Mathematical Association of America.

Section	President	Vice-President	Secretary and Director Central Bureau
a. Geodesy	William Bowie (U. S. Coast and Geodetic Survey)	Vincenzo Reina (Italian Geodetic Commission)	Lt. Col. G. Perrier (Army Geographic Service, Paris)
b. Seismology	Organization deferred		
c. Meteorology	Sir Napier Shaw (British Meteorological Office)	A. Angot (French Meteorological Bureau)	C. F. Marvin (U. S. Weather Bureau)
d. Terrestrial Magnetism and Electricity	A. Tanakadate (University of Tokyo)	Charles Chree (Kew Observatory)	Louis A. Bauer (Carnegie Department of Terrestrial Magnetism)
e. Physical Oceanography	....	H. Lamb (University of Manchester)	G. P. Magrini (Hydrograpic Office, Venice)
f. Vulcanology	A. Riccò (Observatory Etna, Sicily)	H. S. Washington (Carnegie Geophysical Laboratory)	A. Malladra (Vesuvius Observatory)

and Mr. G. W. Littlehales (U. S. Hydrographic Office) were made additional members of the executive committee of that section.

The *officers of the International Union of Geodesy and Geophysics* are: President, M. Charles Lallemand (director, Levelling Service, France); general secretary, Colonel H. G. Lyons (Army Meteorological Service, Great Britain). These two officers, with the addition of the presidents of the Sections, who are the vice-presidents of the Union, constitute the *Executive Committee of the Union.*

According to the method of organization and the interpretation put upon the office of secretary, it is expected that the affairs of the unions and sections, between the triennial meetings of the General Assembly, will be largely conducted by the respective secretaries, as is the case also with regard to the general secretaryship of the International Research Council, to which Professor Arthur Schuster was reelected. Thus, according to the official or French version of the statutes of the Union, which were made to conform to those of the council, the secretary's duties are defined as follows:

> The secretary of a section shall act as director of its central bureau. He shall be responsible for the conduct of correspondence, the management of the resources, the custody of the documents, the preparation and issue of publications and such other matters as the General Assembly may refer to him.

Organization of Work.—In section (*a*) (Geodesy), which is to take the place of the former International Geodetic Association, it was decided to defer the appointment of committees and the organization of international research work in geodesy until the next general meeting (1922) of the Union, or until some previous special meeting. At a joint meeting of geophysicists and astronomers it was finally decided to leave to the International Astronomical Union the future international variation-of-latitude observations.

Section (*c*) (Meteorology) it was generally agreed could usefully and effectively supplement, by confining its work to research and fundamental problems in meteorology, the functions and work of the pre-war International Meteorological Committee. The latter, as it consisted of official weather-bureau directors, necessarily had to concern itself primarily with administrative and official meteorological questions. In the unavoidable absence of the elected president, Sir Napier Shaw, no organization of work was attempted except the passing of two resolutions to the following effect:

> (*a*) That there be appointed a Joint Committee of the International Astronomical Union and of the Section of Meteorology of the International Geodetic and Geophysical Union for investigational work on solar radiation.
>
> (*b*) That international work in atmospheric electricity, as far as possible, be placed under the direction of a committee nominated partly by the Section of Terrestrial Magnetism and Electricity and partly by the Section of Meteorology.

The work of section (*d*) (Terrestrial Magnetism and Electricity) could be more com-

pletely organized than that of the other sections, as it happened that there were present at Brussels six members of the pre-war International Magnetic Commission of the International Meteorological Committee, viz: Agnot (France), Bauer (U. S. A.), Chree (England), Palazzo (Italy), Schuster (England), and Tanakadate (Japan). After the election of the officers on July 24 and discussion of the status of work of the pre-war International Magnetic Commission, the following eight resolutions were passed:

1. That a committee be appointed to consider the best method of securing an adequate comparison of the magnetic instruments in use in different countries, and to consider as to the best method of measuring the magnetic elements in absolute units.

2. That the Section of Terrestrial Magnetism and Electricity concurs in the resolution of the Meteorological Section that international work in atmospheric electricity should be as far as possible placed under the direction of a committee nominated partly by the Section of Terrestrial Magnetism and Electricity, and partly by the Section of Meteorology.

3. That the Section of Terrestrial Magnetism and Electricity would welcome cooperation with the International Union of Scientific Radio-telegraphy in the investigation of the electric phenomena of the higher atmosphere.

4. That a committee be appointed on the systematic exchange of magnetic curves.

5. That special committees be appointed from time to time for the investigation and report on specific problems in terrestrial magnetism and electricity.

6. That the Section of Terrestrial Magnetism and Electricity would welcome cooperation with the International Astronomical Union in investigating the relationships between solar and terrestrial magnetic and electric phenomena.

7. That the ex-officio members of the executive committee be empowered to elect additional members to serve until the next ordinary meeting of the Union.

8. That the executive committee consult with the executive committees of other sections of the Union and report to the general secretary of the Union the amount of funds annually required by the Section during the period of the present convention.

The executive committee of the Section of Terrestrial Magnetism and Electricity on July 25, in order to carry into effect these resolutions, appointed ten committees, the complete composition of which was deferred until the entrance into the Union of other countries. Thus the committee-plan of distribution of international researches in terrestrial magnetism and electricity (atmospheric electricity, earth currents, polar lights, radiotelegraphy-strays, etc.), as adopted by the International Astronomical Union, was also followed in section (*d*) as, in fact, generally in the other sections, as far as they could be organized.

Annual Funds.—The basis of votes and financial contributions is that adopted by the International Research Council, viz:

Population of Countries	Number of Votes on Scientific Questions	Number of Units of Financial Contributions
Less than 5 millions	1	1
Between 5 and 10 millions	2	2
Between 10 and 15 millions	3	3
Between 15 and 20 millions	4	5
Over 20 millions	5	8

Each country may include the native inhabitants of its colonies in its population. Self-governing dominions have a separate voting power according to above scale. It is expected that there will be at least fifty contributing units, hence, the total annual funds which may be available for the international researches of a Union will be about 50 times the unit of contribution, whatever that be finally. The funds are to be obtained, by the International Research Council, through a national research organization, academy, or governmental agency.

It is not possible under the present statutes, for a country to join only one or more of the sections of the Geodetic and Geophysical Union. In this respect, then, the organization of the new international associations (unions) differs from the pre-war ones—a country could join, for example, only the International Geodetic Association, not, necessarily, also the International Seismological Association. As a matter of fact, however,

practically all civilized countries were adherents of the various existing international bodies. Hence the aggregate money contribution per county joining the new international bodies will probably not be any more, more likely less, than under the old system.

The organization of the new international bodies may appear to be not as simple, or perhaps not even as independent, as the former ones. Thus, for example, instead of having such a brief and convenient name as "International Geodetic Association" we would have now "Section of Geodesy of the International Geodetic and Geophysical Union." (The International Research Council does not insist upon having its name also added.) Many of the geophysical delegates from the various represented countries, it appeared, would have preferred the name "International Geophysical Union," in accordance with the original proposal. However the executive committee of the International Research Council, at its preliminary meeting in Paris last May, adopted the expanded name on the motion of the representative of Italy.

Most likely there will naturally come into use simplified designations, as, for example: International Geodetic Section (or committee), International Seismological Section (or committee), etc. This would conform to the corresponding names for the "national sections," as they have been tentatively called in the United States, or "national committees," as they are called in England and France.

The basic idea of retention of the name of section (or of committee) is, of course, that the particular branch of geophysics represented by the section is to be considered as but a part of the broad, general subject of geophysics. The fruitful, fundamental idea is that there will be at least once in three years a general symposium on the main branches of geophysics, rather than independent, uncoordinated meetings on special branches. In that respect there is certainly a great gain in the new organization of geophysical bodies over the old ones. And as far as independence is concerned, it is to be said that the manner of organization admits of much elasticity and large freedom of action of any section apart from the Union to which it may belong, or of the Union apart from the council.

The present convention is to continue for twelve years, beginning January 1, 1920, subject to renewal and modification at the end of this period. The general meetings are to take place every three years when there will be opportunity for changes in organization or statutes, as future experience may suggest. It will not be necessary for a union to meet at the same place as the council, or for all the various unions to meet together. A section may furthermore call a special meeting when found necessary.

The *objects of the International Geodetic and Geophysical Union* are stated in the official version as follows:

1. To promote the study of problems concerned with the figure and physics of the earth.
2. To initiate and coordinate researches which depend upon international cooperation and to provide for their scientific discussion and publication.
3. To facilitate special researches, such as the comparison of instruments used in different countries.

In conclusion, it may not be amiss to say that the six sections of the International Geodetic and Geophysical Union as finally established were in general accord with those the American Geophysical Delegates were instructed to recommend. The French had originally proposed but two sections, Geodesy and Meteorology, to which was added a third, Seismology, in the Royal Society proposals. However, as the result of preliminary, informal meetings at Brussels of the various national delegations, discussion soon developed practical unanimity in the proposals to have each main branch of geophysics represented by an independent section. The resolutions passed by section (*c*) (Meteorology) and (*d*) (Terrestrial Magnetism and Electricity) are good illustrations of the provisions taken also as to cross-relationships

between sections of a union or between different unions.

As far as the future advancement of the particular subjects of Terrestrial Magnetism and Terrestrial Electricity are concerned, it is believed that a step of fundamental importance was taken at Brussels by the assignment of these subjects to a section by itself rather than relegating or subordinating them to some other branch of geophysics with which they might have but a very remote, or even but a purely administrative connection.

Besides receptions tendered by the burgomaster (Adolf Max), the Minister of Education, the Minister of Foreign Affairs, opportunity was afforded for a visit and reception on July 26 at the Uccle Royal Observatories, to whose director, Monsieur G. Lecointe, the signal success of the local arrangements is to be largely ascribed.

Let us hope that the powerful stimulus given geophysical research by the International Research Council will bear the desired fruit and bring about in each country adequate recognition of the needs for the advancement of our knowledge of the physics of the earth!

Louis A. Bauer

A MEDICAL SCHOOL, IN THE WAR AND AFTER

Ladies and gentlemen of the classes entering the Cornell Medical College, on behalf of the President, the Acting Dean and the Faculty, I bid you welcome! A year ago the college opened under the shadow of the world war and saddened also by the death of our great dean, William Mecklenburg Polk. To-day the college reopens with its ranks filled, with new men added to its staff, and with important departments remodeled on modern lines. Dr. Polk's policy of reorganizing one department after another upon sound scientific principles has been continued since his death.

The war brought to every one the opportunity for public service and the lesson will not be lost. The participation of our college in the war is a cause for quiet satisfaction, and perhaps we may pause for a moment to glance at some of the activities of the institution which has been or is to be your intellectual home. A member of our faculty gave up his practise and went to Washington to assume control of important matters there. On speaking to him of his unselfishness, he replied that his lot was not worthy of sympathy when contrasted with the sacrifice of the many young second lieutenants in the medical service, who had their wives and babies at home to be supported by the meager salary paid by the government. This generous sentiment was illustrative of the spirit that spent itself freely for the welfare of the country.

In 1914 Dr. Stimson, a veteran of our Civil War, went from this college into the front trenches with the Belgians and showed them by candlelight antiseptic methods for the treatment of wounds. He returned there again in 1916 and was planning a third trip before he died in 1917.

One of our professors took the New York Hospital unit to France. Another was chief officer in charge of all the pathological laboratories in France. We visualize such men as healing the wounds of those hurt in battle or seeking out new methods of cure in the laboratories behind the lines.

One of the women graduates of this college went abroad as secretary to the head of the Bellevue Hospital unit. When later the chief of that hospital went to the front he left her in charge of the base hospital, the younger men remaining there willingly recognizing her superiority.

Another of our professors was at first chosen to standardize surgical dressings for the American Red Cross. He also trained 135 army surgeons in the surgery of war wounds. This course aroused their enthusiasm both when it was given and later in retrospect abroad, and it brought the comment from the Surgeon-General's Office that it was the best constructed and most comprehensive course given in the country. This

[1] An address of welcome to the students of the Cornell University Medical College, September 29, 1919.

master surgeon finally won his way to the front in France and, although suffering from the results of a grievous fall which brought great pain at every foot-step, he trudged for miles with our advancing armies. This portrays the spirit of courage and sacrifice which should be a fundamental principle in the practise of your profession.

To those who remained at home the mental hardship of so doing was often very great. One of our professors, when asked to enter the service, was bluntly told by Dean Polk, "If you wish to close this school you can accept this offer." So the man stayed at home and nearly lost his life later in gas experiments for the government.

The war brought its special scientific problems. In this school 429 men were trained in roentgenology, and the first portable x-ray apparatus for use in the field was here constructed.

Through a special knowledge acquired in Bellevue Hospital, another professor so perfected the ventilation system in the submarine that one of our United States boats remained submerged for four days, a world record.

From this school went one who had the scientific supervision over the nutrition of the United States Army. Another distributed a million dollars' worth of food among the Serbians and recently left that country with its fields 90 per cent. planted and its people blessing the American officers for their kindly generosity.

Some of our students entered the regular fighting forces, one leaving the college during his second year in medicine and returning as a major. We welcome those men back to their work with us.

Many other services, heroic and intellectual, were rendered by and through this institution during the great crisis. I have mentioned only a few instances which have come to me. It has been said that no man should be vain of personal accomplishment. Davenport says that if an individual has been given great powers of heart and mind which have been properly developed by education, his intelligent reaction to circumstances is a question of innate mental endowment and, therefore, not a matter for personal conceit. It is permissible, however, to say that you, who are now placed in an environment suggestive of moral and mental capacity, may profitably develop your own capacities each according to his individual endowment.

I have briefly sketched the war activities of some of your teachers. They are in this work of teaching, not for financial reward, but in spite of the lack of it. Professors' salaries have not risen during the war but the professors have not gone on strike.

In Ludwig's physiological laboratory in Leipzig there was an old servant named Salvenmoser who had helped the professor for thirty-five years. When Salvenmoser wished his pay raised be became ill and retired to his quarters in the upper part of the physiological laboratory. During this time the celebrated Professor Ludwig could perform none of his celebrated experiments, and as much as a week might pass before the pay was raised; then Salvenmoser recovered from his illness and the experiments were resumed. In thinking over this little story it seems to me to have been prophetic of the workers of the present day, for many of them have been converted into Salvenmosers—willing to thwart the great experiments of world endeavor by feigning illness. But university professors, however underpaid and hard pressed, have not gone on strike, but stand prepared to serve you for the common good.

I do not know how many of you have read an opening paragraph which has for several years been in the catalogue of the Cornell University Medical School:

> The objects of this school are:
>
> 1. To develop physicians of the best type and
>
> 2. To conduct researches into the cause and cure of disease.

As a matter of fact, these two objects are not separable, for in order to produce a modern physician of the best type he must be educated in the atmosphere of developing knowledge which we call research. A cynic of another generation has remarked that the ancients tried to make medicine a science

and failed, while the moderns tried to make it a trade and succeeded. But now the modern trend is in the direction of a true science of medicine.

As you doubtless know, the department of medicine has been reorganized under the wise direction of Dr. Conner. It is our great pleasure to hail the return to Cornell and to the New York Hospital of a man of the exceptional ability of Dr. Foster who for several years has been professor of medicine at the University of Michigan. At Bellevue Hospital the reorganization of the medical clinic by Dr. Conner has placed it in a position to become one of the most powerful influences for medical progress in the country. A full-time staff, Drs. Du Bois, Peters, Barr, Alexander (and McCann will join them), all of whom have been recently discharged from the military or naval services of this country, are giving their entire time for the purpose of instructing students and for carrying on researches into the cause and cure of disease. Three of these men are graduates of the P. and S., two of our own college. Some of the men are supported from the funds of the Russell Sage Institute of Pathology, given by Mrs. Sage for the benefit of the sick poor, and others are supported by friends of the college.

This undertaking followed several years after the introduction of full-time men on the surgical division under Dr. Hartwell. We may all rejoice at the rich opportunities for learning which are offered both in medicine and surgery in Bellevue Hospital.

Another very notable increase in the potential power of the school as a teaching institution has been attained during the summer through the appointment of Dr. Schloss as professor of pediatrics. The true guiding principle of every successful institution has been followed, the appointment of the best man available in the country to fill the place. The highest opportunities for work in pediatrics now lie open to the students of this school and under the best of direction.

An old Swiss physician, Sondereggers, once wrote a letter of advice to a father whose son desired to study medicine, and this letter has so much idealism in it that it seems permissible to read it to you.

There is nothing greater or more beautiful in the world than man. He is the mightiest and most elevated example of thought and education. His existence, his struggle, his suffering, are all in the highest degree wonderful and stimulating. Thou must bring clear eyes and fine ears, a great talent for observation, patience and again patience for endless study, a clear critical mind which grows stronger in time of necessity, and yet a warm, susceptible heart which understands and sympathizes with every sorrow; religion and moral earnestness which have dominion over lust, money and honor; also a becoming exterior, a polished demeanor, health of body and spirit. All these thou must possess or thou wilt be a bad or an unhappy physician. Thou must carry great knowledge even like to a camel's burden, and also preserve the freshness of the poets. Thou must overcome all arts of charlatanry and in so doing remain an honorable man. Medicine must come first and be thy religion and politics, thy joy and thy sorrow. Therefore I would never advise anyone to be a physician. If he still wishes to be one, warn him again and severely; if he wishes it notwithstanding; then give him thy blessing in so far as he is worthy of it; he will need it.

We will be glad to have all students entering this college feel that they are welcome guests to its halls, guests who come as men and women earnestly desirous of enjoying such intellectual opportunities as are here generously offered. I would ask you to show your appreciation of the gifts which private endowment makes possible, in that you should treat the building and its contents with that scrupulous care and reverence which you would naturally bestow upon the personal property of a generous benefactor who was also a great friend. If you accept what there is here in good spirit, and if the external life of the country permits an orderly community life within these walls, you will find opportunities for golden days in the time to come.

Graham Lusk

SCIENTIFIC EVENTS

COOPERATIVE CONSERVATION OF THE INDIANA-LAKE MICHIGAN SAND DUNES

For some time a quiet agitation for the setting aside of this unique region abounding

in rare and valuable flora and fauna specimens has been prevalent in scientific circles. The reservation of this region was formally advocated in a report of Stephen T. Mather, director of the National Park Service at Washington in 1917. The National Dunes Park Association, of which Mr. William P. Gleason, of Gary, Indiana, is now president, has also taken up the matter and has secured a large membership of adherents who enthusiastically advocate the preservation of this wonderland region.

All of these movements have been largely combated by the residents of Porter county, in which the choicest of the dunes are located because of an undercurrent of various misunderstandings. It has been thought by the Porter county residents, and notably the commercial interests of Valparaiso, the county seat, that through a setting aside of the dunes, bordering its fifteen miles of lake front, for a park, would deprive the county of its industrial development which many have held to be paramount to the preservation of those "useless sand hills." The Valparaiso Chamber of Commerce standing primarily for the industrial and commercial development of its valuable water front, strongly opposed any movement looking to the securing of the former objective and the loss of the latter.

Recently there has come into being a new spirit of cooperation. Ex-State Senator Bowser, of Chesterton, Porter county, a director of the National Dunes Park Association has laid a proposal before the Valparaiso Chamber of Commerce, that both bodies cooperate in the attainment of the objectives which have hitherto been considered antagonistic. The bond of cooperation has been formed through the appointment of a general committee, a legal committee and a boundary committee by President John Sievers, of the Chamber of Commerce. Of these the boundary committee consisting of W. E. Harris, Herman Pollentske, Edward Morgan, J. G. Johnson, Guy Stinchfield, George Pearce, Frank R. Theroux have reported in favor of a three-mile lake front park dedicated to Porter county, but this committee wisely qualified their report by stating that the final settlement of boundaries could not yet be determined and many related interests and questions would need to be considered before the limits could be fixed.

It is significant that at a later meeting the Valparaiso Chamber of Commerce passed the following resolution which shows that the business men of Porter county appreciate the importance of the dune conservation undertaking.

> The Valparaiso Chamber of Commerce recommend to the National Dunes Park Association that a board of three consulting engineers be appointed before any final steps on ultimate boundary lines are taken. An industrial engineer to be selected by the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society of Civil Engineers; an engineer on town planning by the Society of American Architects; and a scientist by the Agricultural Department and the Smithsonian Institution to plan coordinately for the proper relation of the industrial, esthetic and scientific Dune-Land heritage nature has placed in the lap of Porter County.

THE IOWA POLICY CONCERNING STATE PARKS

The thirty-seventh General Assembly of the State of Iowa authorized the creation of state parks out of funds from the fees obtained from hunters license fees. It provided that $50,000 be taken out of this fund and on the recommendation of the fish and game warden and the Iowa State Board of Conservation to the executive council state parks could be created and lakes improved. The governor and executive council later (in 1917) appointed L. H. Pammel, of Ames, Joseph Kelso, of Bellevue, and John F. Ford, of Fort Dodge, members of this board, the curator of the historical department being an ex-officio member. The board met and elected Mr. E. R. Harlan secretary and L. H. Pammel chairman.

This board and the fish and game warden recommended the purchase of what is known as the Devil's Backbone Park in northwestern Delaware county. The executive council directed the purchase of some 1,200 acres

along the Msquoketa River, embracing one of the few trout streams left in Iowa, containing also some magnificent old white pine. This park was to have been dedicated on October 1, but owing to unprecedented rains the matter of dedication was postponed. The park was to have been presented by L. H. Pammel on part of the State Board of Conservation and accepted by Governor W. L. Harding. Five-minute talks were also to be given by other members of the board.

A second state park has recently been established in what is known as the horseshoe bend of the Des Moines River near Keosauqua. The board and executive council also authorized the purchase of the largest boulder of the Iowan drift in the Mississippi valley, and three acres of land surrounding the boulder.

The Keosauqua area of 1,123 acres contains a large number of interesting native trees especially oaks and shrubs. Among the birds, some of the rarer species in Iowa are found here, like the drumming pheasant. Bob white is abundant. The board went so far as to get the signatures of all farmers within a mile from the park to preserve this area outside of the park as a wild-life reserve.

The policy of the board will be, to keep the lakes and purchase land on the shores for state parks, to establish one or more highways or county parks in many of the counties in the state. The larger parks are to be for the "preservation of places of historic, natural or recreational interest authorizing donations in aid of such purposes and to make an appropriation therefore, provided for aid by municipal corporations and authorizing boards of supervisors to extend county road systems." Many generous gifts have been made. The Brandt sisters of Davenport donated 57 acres in what is known as "Wild Cat Den," containing some rare ferns and interesting from an ecological standpoint. The citizens of Farmington and Van Buren county purchased outright 100 acres containing a lotus (*Nelumbo lutea*) pond of 40 acres.

There have been more than 100 petitions for state parks. Where it is not possible to buy at this time leases are made so that the wild life may be preserved along the Yellow River in Allamakee county and the Ice Cave near Decorah. The thirty-eighth General Assembly appropriated $100,000 annually for the creation of these parks, eliminating the fish and game warden so that the recommendations now are direct to the executive council from the State Board of Conservation.

MATTERS OF SCIENTIFIC INTEREST IN CONGRESS[1]

Mr. Fess has reintroduced his bill for a national university, which failed of final action in the Sixty-fifth Congress. The present bill is H. R. 9353: "To create a national university at the seat of the Federal Government." The institution, to be known as the "National University of the United States," is to be governed by a board of trustees, consisting of the U. S. Commissioner of Education and twelve appointed members; the acts of the board are subject to approval by an advisory council, consisting of one representative (usually the president of the State University) from each state. No student is to be admitted unless he shall have obtained the degree of master of science or master of arts from an institution of recognized standing. No academic degrees are to be conferred. An initial appropriation of $500,000 is provided. The bill was referred to the Committee on Education.

A fact of interest to the scientific public is that the "Army reorganization bill" (S. 2715, Mr. Wadsworth; and H. R. 8287, Mr. Kahn) makes no mention of the Chemical Warfare Service. In his letter accompanying the bill, Secretary of War Baker suggests that the Chemical Warfare Service be made a part of the Engineer Corps. The proposal to abolish the Service as a distinct unit, comparable with the Tank Corps, is being vigorously opposed by the Council of the American Chemical Society.

Warnings issued by the Public Health Service in September that a recurrence of the 1918 pandemic of influenza was probable in

[1] From the *Journal* of the Washington Academy of Sciences.

the autumn months of 1919, stirred renewed interest in the various bills and resolutions providing for investigations of that disease, but no final action had been taken at the time of this report, although Mr. Harding's S. J. Res. '76 was reported in the Senate on October 1.

On September 3, Mr. McKellar introduced S. 2920: "To enable the Secretary of Agriculture to carry out investigations of the causes and means of prevention of fires and dust explosions in industrial plants." The bill provides $100,000 for such investigations. Referred to the Committee on Agriculture and Forestry.

A plan for private development under Federal concessions, of the platinum resources of Alaska is contained in H. R. 8988: "To incorporate the United States Platinum Corporation and to aid in the development of the mineral resources of Alaska, and for other purposes," introduced on September 3 by Mr. O'Connell (by request). The proposed Corporation would have a capital stock not to exceed $50,000,000; would be exempt from Federal taxation; would be empowered to receive concessions and leases of government-owned platinum sands in Alaska; would pay a royalty of one eighth of its net products; and would furnish $100,000 for the maintenance of five "U. S. Government Commissioners of Platinum and its Allied Industries," whose duties are not defined in the bill. Referred to the Committee on Public Lands.

No action was taken on the invitation of the French government to send delegates to a meteorological conference in Paris on September 30, and the United States was, therefore, not officially represented.

AMERICAN ORNITHOLOGISTS' UNION

THE thirty seventh stated meeting of The American Ornithologists' Union will convene in New York City, from November 11 to 13. The headquarters will be at The Belleclaire, Broadway and 77th Street. Owing to the crowded condition of hotels in New York, members intending to be present are urged to make reservations well in advance. Reservations might also be made at The Pennsylvania, opposite the Pennsylvania Station, 7th Avenue and 33d Street.

The public meetings will be held at the American Museum of Natural History, 77th Street and Central Park, West, from 10 A.M. until 4 P.M. each day. The reading of papers will form a prominent feature of the meetings. All classes of members are earnestly requested to contribute, and to notify the secretary before November 5, as to the titles of their communications, and the length of time required for their presentation, so that a program for each day may be prepared.

As this is the first meeting since the war, interesting reports may be expected from some of the members who served in the military or naval service. In addition to the usual social features there will be opportunities to visit the New York Zoological Park, the Brooklyn Museum, Audubon's home in Audubon Park, and the New York Historical Society, where the original drawings of Audubon's Birds of America are preserved.

Each member is requested to recommend to the secretary the name of at least one new associate for election to the union.

T. S. PALMER,
Secretary

1939 BILTMORE ST., N.W.,
WASHINGTON, D. C.,

SCIENTIFIC NOTES AND NEWS

DR. THEODORE W. RICHARDS, professor of chemistry at Harvard University, and director of the Wolcott Gibbs Memorial Laboratory, has been elected a foreign member of the Royal Society of London.

PROVOST EDGAR F. SMITH, of the University of Pennsylvania, received the degree of doctor of laws from Queen's College at Kingston, Ontario, at the convocation of Canadian universities on October 16.

DR. FREDERICO GIOLITTI, formerly professor of metallurgical chemistry and metallography at Turin has been presented with the Bessemer medal of the British Iron and Steel Institute.

DR. ERIC K. RIDEAL, a graduate of Cambridge University and of the University of

Bonn, more recently captain of the Royal Engineers in the British Army, has been appointed visiting professor of physical chemistry at the University of Illinois for the current year.

Professor George C. Whipple, of Harvard University has been appointed director of the division of sanitation in the bureau of hygiene of the International League of Red Cross Societies. The associate director will be Colonel Francis F. Longley, U. S. A., who served as colonel of the 26th Engineers in France.

The Massachusetts Forestry Association has submitted to the Governor of Massachusetts the names of Herman H. Chapman, of the Yale Forest School, New Haven, Connecticut; E. C. Hirst, state forester of Concord, New Hampshire, and William C. Howard, assistant superintendent of the State Forests, Albany, New York, as candidates to head the Massachusetts Division of Forestry, and also to fill the office of commissioner of conservation.

Among the war prizes awarded by the French Academy of Sciences are the three Montyon prizes of £100, given respectively to MM. Louis Martin and Auguste Pettit, of the Pasteur Institute, for a memoir of icterohemorrhagic spirochetosis; MM. Weinberg and Seguin, of the same institute, for a research on gas gangrene; and MM. Rouvillois, G. L. Pédeprade, and A. Basset for their studies on war surgery. A prize of £120 was awarded to M. Paul Ravaut for his researches on paludism, and one of £80 to M. Goris for studies on the localization of alkaloids and glucosides in vegetables and on the preparation of catgut.

Dr. W. H. Rankin, for five years assistant professor of plant pathology in the New York State College of Agriculture at Cornell University, has been appointed officer in charge, Field Laboratory of Plant Pathology, St. Catherines, Ontario, in the Canadian department of agriculture, and has entered upon his duties.

Professor J. O. Arnold, dean of the faculty of metallurgy and professor of metallurgy in the University of Sheffield since 1889, has retired.

Dr. Elwood Mead, professor of rural institutions in the University of California and chairman of the California Land Settlement Board, has been appointed a member of the National Bureau of Economic Research.

Dr. Oliver Kamm, assistant professor of organic chemistry in the University of Illinois, has returned to Urbana after an eight months' leave of absence spent in organizing a chemical research laboratory for the American Writing Paper Company, at Holyoke, Mass. Dr. R. E. Rindfuss, of the University of Illinois, has accepted a permanent position with the same company as director of Chemical Research. Dr. Kamm remains connected with the company in an advisory capacity.

Mr. Paul C. Standley, of the Division of Plants, U. S. National Museum, has returned from a collecting trip through Glacier National Park, Montana. Data were secured for a handbook of the plants of the park, to be issued by the National Park Service.

Professors Edward W. Berry and Joseph T. Singewald, Jr., of the Johns Hopkins University, have returned to Baltimore, after spending six months in geological investigations in the South American Cordillera. Over one thousand miles were traversed on mule-back and the Andes were crossed eight times between Huancayo, Peru and Concepcion, Chile. Much valuable material was shipped home. The expedition was made possible by a fund in memory of the late Professor George H. Williams.

Professor Olaf P. Jenkins has resigned from his position as geologist to the Arizona Bureau of Mines, University of Arizona, at Tucson, to undertake geological work in foreign countries for S. Pearsons & Son, Ltd., of London.

Dr. C. Bonne and his wife, Mr. C. Bonne-Wepster, of Surinam (Dutch Guiana), students of South American mosquitoes, are spending two months at the National Museum in the study of the mosquito collection.

ALFRED F. BARKER, professor of textile industries at the University of Leeds, England, has been visiting the United States.

Nature states that the Scandinavian Association for a Tropical Biological Station has decided to send an expedition this autumn to select a site for a research station to study marine biology. Dr. Th. Mortensen, who is chairman and founder of the association, will lead a small party including probably Dr. Nils Holmgren and a botanist. They will visit Celebes, North Borneo, Amboina, and New Guinea.

DR. VITO VOLTERRA, professor of mathematical physics in the University of Rome, and a member of the Italian Senate, delivered six lectures on the Hitchcock foundation at the University of California, between October 13 and October 21. The subject of the first four lectures was "The Propagation of electricity in a magnetic field," and that of the last two was "Derivate functional equations." During his stay in California he visited the Yosemite Valley and was a guest of Director Campbell at the Lick Observatory and of Director Hale, at the Mount Wilson Observatory. After visiting the Grand Canyon of the Colorado he will go to Houston, Texas, where he will give some lectures at Rice Institute. From there he will go to the Atlantic coast, where he will visit a number of universities.

A SERIES of fortnightly lectures on industrial problems are being delivered at the Guildhall, London, under the auspices of the Industrial League and Council. The speakers will include Mr. E. J. P. Benn, Professor Ripper, Dr. Russell Wells, Sir Auckland Geddes, Sir George Paish and Lord Emmott.

J. W. H. TRAIL, F.R.S., who for fifty-two years held the chair of botany at the University of Aberdeen to which he was appointed at the age of twenty-six, died on September 18.

IT is stated in the *Journal* of the Washington Academy of Sciences that the proposed American Meteorological Society, formal organization of which is suggested for action in connection with the next meeting of the American Association for the Advancement of Science, is expected to have a large Washington membership, drawn from the staff of the Weather Bureau and from among the meteorologists of the Army and Navy. It is suggested that the *Monthly Weather Review* be made the medium for publishing meteorological and climatological articles, while a monthly leaflet published by the society would contain news, announcements, notes and queries.

THE following resolution was adopted by the technical Association of the Pulp and Paper Industry at the meeting held in Chicago, for September 24 to 27.

WHEREAS, due to the decay of pulpwood and woodpulp the paper industry is suffering an annual loss of $5,000,000, and

WHEREAS, in order to reduce this loss to a minimum a scientific investigation of the cause and possible control of such infection is essential, and

WHEREAS, The Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wis., is in an exceptional position to undertake this special investigation, Therefore,

Be it resolved, that this association use every means within its power to secure a specific appropriation of $50,000 for this special investigation to be conducted by the Forest Products Laboratory, United States Department of Agriculture, Madison, Wis.

THROUGH the action of the congressional Public Buildings Commission, of which Senator Smoot is chairman, the U. S. Geological Survey has been compelled to give up to the Internal Revenue Bureau nearly half of its office space in the Interior Department Building. *Economic Geology* says: "This by forcing as many as three geologists to work in a single small room with no adequate space for the study of maps and collections is a serious blow at the efficiency of the organization. The action is an example of the failure of Congress to understand the nature of scientific work and to realize that a geologist's room is essentially a laboratory within which it should be possible to retain in accessible condition, collections of minerals, rocks and ores representing field work that in some investigations may extend over a period of several years."

UNIVERSITY AND EDUCATIONAL NEWS

THE late Sir Samuel McCaughey has bequeathed $2,000,000 to the University of Sydney and $1,250,000 to the University of Brisbane.

DR. G. McPHAIL SMITH, formerly of the University of Illinois, has been appointed head of the inorganic division of chemistry at the University of Washington, Seattle.

DR. ROBERT GESELL, of the department of physiology in the Washington University Medical School, St. Louis, has been appointed professor of physiology in the University of California.

DR. H. I. COLE, who served overseas as captain in the U. S. Chemical Warfare Service, and was lately associated with the Arthur D. Little Corporation as chemical microscopist, has accepted the appointment of professor of chemistry at the University of Oregon during the absence of Professor Stafford who will be engaged during the coming year in private research in the east.

DR. HIRAM BYRD, formerly scientific secretary of the State Board of Health, of Florida, has accepted the directorship of the Department of Hygiene in the University and the Interdepartmental Board of Social Hygiene.

PROFESSOR BOHUMIL SHIMEK, head of the department of botany in the State University of Iowa, requested last spring that he be relieved of administrative work and much of his teaching in order that he might concentrate on his research. Dr. Robert B. Wylie, professor of morphological botany, was then made head of the department. These changes have been effective for the present academic year.

THE following appointments have been made on the Faculty of the Marquette School of Medicine: Fred T. Rogers, Ph.D., formerly assistant professor in the department of physiology, University of Chicago, professor and director of the department of physiology; Otto F. Kampmeyer, Ph.D., formerly connected with the University of Illinois, associate professor of anatomy; Albert J. Bruecken, M.D., formerly pathologist and bacteriologist in Mercy Hospital, Pittsburgh, and demonstrator of pathology at the University of Pittsburgh, junior professor of bacteriology; S. C. Henn, Jr., M.S., formerly fellow in the department of physiology, University of Chicago, instructor of physiology, and John Tilleman, A.B., assistant, in the department of pathology.

B. M. JONES, Emmanuel College, has been elected to the Francis Mond professorship of Aeronautical Engineering at the University of Cambridge, founded by Mr. Emile Mond in memory of his son, who was killed in the war. Mr. Jones obtained honors in the mechanical sciences Tripos of 1909, and from 1919 to 1912 he was employed on aeronautical research at the National Physical Laboratory. During the war he became assistant controller of experiment and research in the Armament Experimental Station with the rank of lieutenant-colonel.

DISCUSSION AND CORRESPONDENCE

UNIFORMITY IN SYMBOLS

THE hapless student beginning work in aerography and aeronautical engineering, today, may well sympathize with the writer in SCIENCE,[1] who two years ago expressed the wish that some uniform set of symbols might be used. He spoke as a sorely tired reader of recent contributions in meteorology, astronomy and geodesy. His closing appeal was "*Don't let details smother uniformity. Make a start.*"

Up to the present time the number of those starting is not impressive, and although we do not want to rush in where angels (?) fear to tread, we venture now to offer a tentative set of symbols for the guidance of those who contemplate work in aerography and allied subjects.

That the perplexity is a real one will appear when we mention that in a recent memoir on dynamic meteorology the letter γ has three different meanings, viz: ratio of specific heats, gravity and temperature gradient. Some

[1] Dr. Otto Klotz, SCIENCE, Vol. XLVI., No. 1189, p. 360, October 12, 1917.

writers, especially the English, use this same symbol for the gradient wind. So too with λ. In astronomy it indicates longitude, in physics, wave-length; but some recent writers on meteorology and aeronautics use it for latitude.

Again, in tracing the development of a formula, one will meet for atmospheric pressure, p, b, P, B, h and H used indiscriminately; v for volume, velocity or radiation; s may be space or seconds; t time or temperature; and R may be a gas constant or the radius of the earth.

We therefore venture to make the start by proposing the following which it is thought conform to the best and latest usage.

$\phi =$ latitude.

$\lambda =$ longitude.

$\pi = 3.1416$.

$e =$ base nat. logs. 2.718.

$\omega =$ angular velocity of earth's rotation. $= 2\pi/86{,}164$ sec. $= .00007292$.

$\kappa =$ ratio of specific heats, constant pressure to constant volume.

$\kappa_1 = k$ for air $= .2375/.1683 = 1.41$.
k for water vapor $= .4734/.3631 = 1.30$.

$C_{p_A} =$ specific heat dry air at constant pressure, in heat units .2375.

$C_{v_A} =$ specific heat dry air at present volume, in heat units .1683.

$C_p =$ specific heat dry air at constant pressure in grav. force 9935787.

$C_v =$ specific heat dry air at constant volume in grav. force 7065453.

$\rho =$ density.

$\rho_1 =$ density of water at standard conditions $= 1$.

$\rho_2 =$ density of dry air at pressure 1,000 kilobars and temperature, 1,000 kilograd 1,276 gms./cu. m.

$\rho_3 =$ density of water vapor pressure 1,000 kilograd $= 5$ gms./cu. m.

$g_0 =$ acceleration due to gravity at 45 latitude and sea-level, 980.615 cm./sec^2.

$g_v =$ gravity potential $= g_0/1{,}000z$.

$\frac{dg_0}{z} =$ normal gravity decrease with altitude $=$ .0003086 dynes/meter.

$b =$ bar or unit of pressure expressed in force $= 1$ dyne/cm.^{2}.

$kb =$ kilobar or 1,000 bars, the pressure unit commonly used.

$mb =$ millibar or 1/1,000 bar.

$mgb =$ megabar or one million bars. This pressure is an absolute atmosphere of .987 of the old sea-level atmosphere. It is the pressure given by 750.1 mm. of mercury (29.53 inches).
One megabar atmosphere acting through one cubic centimeter does one megerg of work.

$1/A =$ mechanical equivalent of heat $= 42683$.

$g_0/A =$ gravity work of heat $= 41{,}851{,}000$ ergs.

$A =$ heat equivalent of work $= .000023$.

$A/g_0 =$ heat equivalent of gravity work $= .000000023$.

$v =$ volume; $m_s =$ mass; $l =$ length; $vel. =$ velocity; $z =$ vertical distance; $p =$ pressure.

$r =$ radius; $s =$ second; $m =$ meter; $m/s =$ meters per second.

$R =$ gas constant, which is not a constant in the atmosphere, for there is circulation and gain or loss of heat. The student should question all equations in atmospherics in which it is assumed that the gas coefficient is a constant.

$R = 2{,}870{,}000$ if pressure is in bars.

$T_F =$ temperature on the Fahrenheit scale. Freezing 32°; boiling 212°.

$T_C =$ temperature on the Centigrade scale. Freezing 0°; boiling 100°.

$T_A =$ temperature on the Absolute Centigrade. Freezing 273°; boiling 373°.

$T_K =$ temperature on the Kilograd. Freezing 1,000°; boiling 1,366°.

Ratio of scales: 1 degree F. $= 2.04$ K.
1 degree C. $= 3.66$ K.
1 degree K. $= 0.491$ F.
1 degree K. $= 0.273$ C.

$\sigma =$ radiation constant $= 5.7 \times 10^{-12}$.

$N =$ Avogadro constant $= 6.06 \times 10^{-23}$.

$n_0 =$ number of gas molecules per cu. cm. at 1,000 kbs. pressure and 1,000K. temperature $= 2.705 \times 10^{19}$.

$m_h =$ mass of hydrogen atom $= 1.662 \times 10^{-24}$.

$e_l =$ electron $= 4.774 \times 10^{-10}$.

$Q =$ heat energy; $W =$ external work; $U =$ inner energy.

$r_{eq} =$ earth's radius at equator $= 6{,}378{,}388$ meters (3,963 miles).

ALEXANDER MCADIE,
GEORGE P. PAYNE

BLUE HILL OBSERVATORY,
October 18, 1919

OROGENICS OF THE GREAT BASIN

WHEN, about forty years ago, the members of the Fortieth Parallel Survey leisurely traversed the mile-high Great Basin between the lofty Rockies and the Sierra Nevada, their impressions on the configuration of the mountain ranges were that there was chiefly folding of the Appalachian type wherein the synclines were deeply and almost completely filled with illy transported rock-waste from the neighboring highlands.

A decade later, corps of other governmental surveys, passing through this part of the country, put an entirely different interpretation on the origin of the rugged desert ranges. Novel as well as brilliant was the conception that these mountains were recently tilted fault-blocks of gigantic size. This fancy led to another brilliant idea—the hypothesis of isostatic compensation, whereby there is ready response to the transference of eroded rock materials from one point to another, loading areas sinking and unloading areas rising.

Curiously enough when the isostatic hypothesis came to be critically tested in the field no faults bounding the orographic blocks were discoverable. More than a third of a century passed since the idea was first promulgated and yet no one appeared to find impeachable evidences of the alleged crustal ruptures. A governmental expedition, especially fitted out to solve the problem and headed by the author of the hypothesis himself, failed to establish the claim or to publish the desired data. Many of the so-called fault-scarps which were described as marking the basin ranges proved not to be fault phenomena at all, but merely characteristic features of normal eolic erosion at the level of maximum activity. Other investigators searching especially for the assumed faults found not major lines of this character bounding the present mountains but instead discovered dislocation phenomena in the most unexpected situations—far out on the smooth intermontane plains. There was manifestly no genetic relationships existing between mountain profile and geologic structure. On the whole the proposed hypothesis of Basin Range structure proved to be singularly unsupported by observation.

In the meanwhile testimony of another kind abundantly accumulated bearing upon the problem. When the presence of faulting was all but completely discredited, it was shown that although extensive rupturing actually occurred in the region it was mainly relatively ancient. It long antedated the time when the present mountains took form.

There is, however, a third possible explanation of the faulting phenomena displayed in the Great Basin. The major faulting of the region may not be of the normal gravity type as is so commonly supposed. It may be mainly of overthrust character. In support of this suggestion, as a general proposition, there are a number of considerations besides the almost conclusive theoretical one. A remarkable circumstance is that some of these thrust-planes in the desert ranges are often mistaken for lines of unconformities. This may be the real reason why so few normal faults are found bounding the mountain blocks. The overpowering influence of the normal fault idea has much to do with the general misinterpretation of Basin Range orogeny.

Concerning the tectonic genesis of the desert ranges we shall now probably have to give up our brilliant conceptions of mountain blocks floating on the liquid interior of the earth much after the fashion of ice-cakes in a river at time of spring break-up. What the substitute shall be may not yet be perfectly clear. Mountains of circumdenudation through the differential activity of eolic erosion under the stimulus of the aridity and over a region previously effected widely by overthrust movements seems more nearly in accordance with the larger aspects of the conditions presented. At least the extent of the overthrust activity is worthy of the most careful consideration and severest test in the field.

CHARLES KEYES

DISTRIBUTION OF THE FRESH-WATER MEDUSA, CRASPEDACUSTA, IN THE UNITED STATES

IN SCIENCE, November 8, 1907, the writer published a brief account of the appearance

of this interesting medusa in this country, and in the *Biological Bulletin* of April, 1908, described in some details the history of the case, and evidence of its identity with *Limnocodium sowerbii* of Europe. These were the first accounts of this species in the United States, and its occurrence at that time in the aquarium of a green-house in Washington, D. C., used by its owners for propagating exotic tropical plants, suggested its possible introduction by means of such plants. But the assurance of the proprietor that only the *seeds* of such plants were imported threw serious doubt upon such an inference.

In SCIENCE, December 15, 1916, Professor H. Garman reported a most interesting occurrence of this medusa in Benson creek near Frankfort, Kentucky, and later the present writer received from Professor Garman specimens which were identified as the same as those formerly described from the Washington aquaria. Here in this fresh-water stream, a small tributary of the Kentucky river, far removed from any possible source of artificial introduction, the occurrence of "millions" of these medusæ, at once utterly discredited the earlier asumption of distribution by artificial means from tropical sources of its assumed habitat.

On October 4, 1919, I received from Professor F. Payne of Indiana, a letter announcing the finding of these medusæ in a lake in northern Indiana, and on the following day an official communication from the Bureau of Fisheries announcing its receipt from "Boss Lake" near Elkhart, Indiana, of medusæ presumed to be the same as those formerly described from Washington, D. C., and later from Kentucky, as cited in the above paragraph, and this was easily verified on the receipt of excellent specimens preserved in formalin. These were accompanied by copies of letters from Mr. J. C. Boss, owner of the small lake mentioned above. This lake was constructed by Mr. Boss, and the following abstract from his letter to the Commissioner of Fisheries will be interesting.

Boss Lake resulted from the overflow caused by the building of a large dam on the St. Joseph River. Our family owned and operated a brick yard at a point on said stream the backwater of which flooded so large a portion of the clay bank that it ruined it for commercial purposes. A large dyke was built between the clay pit and the river, reinforced by puddled clay to make it as nearly as possible water tight so we might raise the water to a height of about seven or eight feet above flood tide of the river; this purpose was accomplished effectively and the lake so stands to-day. The lake contains about four acres, is fed by surface spring water and an artesian flowing well, the level remaining constant.

This lake has been stocked with Black Bass supplied by the Bureau of Fisheries, and Mr. Boss states "there have never been any plants from other lakes introduced or planted in this, especially not of exotic species," though it abounds in native aquatic grasses, he states.

A most interesting feature comes to light in the data furnished by Mr. Boss, namely, that the medusæ were first observed one year ago, then very few in number. This year about August first they again appeared and in greater numbers, and during "ten days we have seen millions, they come to the surface on warm sunshine days." That is, not only have these formerly supposed tropical medusæ established themselves in northern waters, and persisted over winter, but have greatly multiplied during the second year, hence breed freely under these conditions. Those found in the Kentucky creek apparently disappeared very suddenly, as did those in the Washington aquaria as reported in my former papers, on the approach of cooler weather; and in neither of these localities have they reappeared, so far as known, Professor Garman stating his purpose to closely follow up the matter the following year having made no further report.

These several occurrences of this medusa in the fresh waters of this country clearly proves that it has become an indigenous faunal factor and clearly able to perpetuate itself, and further that it has not at any time been introduced through artificial means from remote regions. It still remains prob-

lematic as to the precise processes of its distribution, propagation and life history. But among the present material numerous female specimens occur, a feature not previously described. Hydroid phases of the organism have been but vaguely suggested.[1]

C. W. HARGITT

SYRACUSE UNIVERSITY,
October 11, 1919

SCIENTIFIC BOOKS

Observations on Living Lamellibranchs of New England. By EDWARD S. MORSE. Proc. Boston Soc. Nat. Hist., Vol. 35, no. 5, July, 1919, p. 139–196, Figs. 1–48.

The state of New York once published an imposing quarto report on its mollusca of which the only feature remaining in the memory of the present reviewer (except the minus value of that part supposed to cover the nudibranchs) is an exquisite hand-colored engraving, nearly life size, of a common "horse-mussel" shell showing every accidental scratch, every adhering bit of alga or barnacle, every growth line, each abraded spot, a piece of dried mud and a chipped place on the margin, with more than photographic minute accuracy. It was impressive. It was costly. It was uninspired, It was valueless.

Professor Morse's little paper is in every respect the opposite. Its 57 octavo pages and 48 rough outline text figures probably cost all together a small fraction of what that gorgeous portrait of a mussel shell alone cost the state of New York. But those pages add more to our knowledge of American molluscs than the entire imposing quarto and each simple drawing is a work of true art. Of some it is not too much to say that, while drawn for the sake of the soft parts alone, and practically confined to outline, they constitute the most characteristic extant representations of the shells. It must have been his years of intensive study of Japanese pottery that gave Professor Morse full appreciation of the value of subtly correct outlines and the importance of omitting non-essentials, for although his work shows he was already an artist when he first published figures of molluscs fifty-five years ago, and his drawings of living brachiopods have been famous for their vital accuracy, it seems to have been reserved for his return to biology after his Japanese interlude, and for the riper age of eighty-one years, for him to attain the acme of the art of telling with his pencil the most, and the most truly, about an animal in the most simple way.

Although American malacology has, if anything rather more fully than European, recognized theoretically that the "soft parts" are, after all, the animal that is being studied, and the shell (except as a paleontological marker) of little value except for what it can tell us about that animal, yet in practise it has fallen woefully behind Europe in study of the animal as distinguished from its shell. This is particularly true of the marine Pelecypods. Pilsbry and others, successors of Binney, have elucidated our land snails, while Baker and Walker have thrown a flood of light on our fresh-water Gasteropoda, and Ortman, Sterki and others under the stimulus of Simpson's work on the Naiades have dealt fruitfully with the fresh water Pelecypoda. The marine Gasteropoda have had more scattered attention but on the whole their bolder habits and more varied and striking anatomy have attracted a considerable mass of observation, while the shy and rather monotonous animals of the marine Pelecypoda have been neglected. There have been a few intensive studies of single forms by Drew and others; but Dall and Verrill, whose work on this group outbulks many times over that of all others combined, have handled chiefly fossil or deep-sea or preserved material or else "just shells" as usually sent in by the amateur collector. Thus a large proportion of the present paper consists of novel observations while the graphic records of those observations are almost wholly novel.

One could wish that Professor Morse had

[1] Since the foregoing notes were written I have received later statements from Dr. Payne that he has made several trips to the lake and has undertaken fuller investigations than are at present possible to me, and will doubtless issue them in due time.

gone on to make comparison with allied European forms as beautifully figured in Meyer and Möbius' "Fauna der Kielerbucht" and elsewhere, but he has stopped with a bare record of facts from which he leaves others to extract the conclusions.

The feature of the paper which will excite the most comment, though the least worthy of it, is the savage onslaught on present-day nomenclatorial methods, backed up by the deliberate retention of the nomenclature of fifty years ago as seen in the classic "Binney's Gould." Since the author expressly states that he follows this particular work consistently, and since that work is so important that its names are included in the synonymy of almost every modern list, no actual doubts can arise from this course. It will be easier for any student hereafter to ascertain the correct name of any of Morse's forms that it would have been if, for instance, he had used the 1915 nomenclature when he ought to have followed the fashion of 1919. Particularly is this true as to the generic names, but it does seem a pity not to use a certain discrimination as to specific names. For instance, to call Gould's "*Modiolaria discors*" a "*Modiolaria*" can cause no doubt or confusion even though "*Modiolaria*" has suffered a recent dislocation very likely temporary. But to call it "*discors*" when it is really *substriata* Gray and widely distinct from the strictly European *discors* for which Gould mistook it, is to perpetuate a demonstrated error of fact.

As for the slashing attack on modern nomenclatorial vagaries it probably will have small effect; first because it covers a field already well debated and second because the criticism is almost entirely destructive. It may fairly be said that Professor Morse is as much at fault for failing to recognize that the old system had become nearly intolerable as the perpetrators of the new system are for failing to recognize that it is equally nearly intolerable if not more so. It may serve a useful purpose if it helps awaken the conscientious and learned but timid and unimaginative men who have made a mess of modern nomenclature to the fact that while they are repelling young students and driving them to other fields on the one hand, they are disgusting and irritating old masters to the point of open rebellion on the other.

The paper contains altogether too many typographical errors; and a few slips on the author's part—as where he says (p. 167) that besides *Glycimeris siliqua* the only other form he is acquainted with having the anal siphon larger than the branchial is *Anatina papyracea* and then (p. 190) both figures and describes *Ceronia arctata* as showing the same condition.

F. N. BALCH

BOSTON, MASS.

SPECIAL ARTICLES

RESEMBLANCES BETWEEN THE PROPERTIES OF SURFACE-FILMS IN PASSIVE METALS AND IN LIVING PROTOPLASM, II.

ACTION OF SALT SOLUTIONS AND ORGANIC COMPOUNDS. ANTAGONISMS

PURE solutions of the majority of neutral salts activate passive iron, at a rate which varies with the nature and concentration of the salt. Both classes of ions are concerned in the effect.

In general the stability of the surface-film in any solution—and hence the preservation of the passive state—is intimately dependent upon the oxidizing properties of the dissolved substances. Many solutions whose oxidizing power is insufficient to impart passivity to active iron retard or prevent the spontaneous return of the passive metal to the active state; this is true, *e. g.*, of weak solutions of nitric acid or bichromate ($m/10$ to $m/50$). Obviously when a solution imparts passivity it also preserves it, but the reverse is not always true. In media with no definite oxidizing action, *e. g.*, distilled water, passivity soon disappears; continued oxidation seems necessary for its preservation.

The following experiments have aimed at a more precise determination of the conditions under which the passive state is preserved or destroyed in different solutions; evidently such conditions correspond to the conditions of stability of the surface-film. Iron wires

were first passivated by exposure to 1.42 HNO_3; they were then washed thoroughly in distilled water[1] and transferred to the solution under examination; after the lapse of a measured time of exposure they were again washed in water and placed in dilute HNO_3 (*s. g.*, 1.20). If activation has occurred in the solution, darkening of the surface and effervescence begin instantly; while if the exposure has been insufficient, no effect is seen and the wire remains passive.

In most solutions of salts and other electrolytes a spontaneous return of activity occurs after a greater or less interval, the length of which depends upon the nature and concentration of the compound. In the total effect produced by the solution both classes of ions are concerned; and no relation of activating or passivating influence to the sign of ionic charge is apparent. All ions of strong oxidizing properties tend to stabilize the passive condition (*e. g.*, Cr_2O_7, MnO_4, Ag, Au, Pt), while others (especially Cl, Br, I) have a strong activating influence, referable possibly to a colloidal (aggregative or dispersive) action upon the film. In pure solutions of alkali and alkali earth salts (except those with strongly oxidizing anions like MnO_4 and Cr_2O_7) passivity is always soon destroyed, within periods ranging from a few seconds or minutes to half an hour or sometimes longer. The presence of oxygen in the anion (especially if in a terminal position) appears always to retard the process of activation. In solutions of nitrates, chlorates, phosphates, sulphates, carbonates, tartrates, citrates, acetates ($m/2$ to $m/20$) passivity remains for usually several minutes; activation is more rapid with hydrates; while halides in much lower concentration activate within a few seconds.

Different specimens of iron vary considerably in the time required for activation in a given solution, apparently because of variations in the finer structure of the metal. All of the following observations were made with the same kind of wire (no. 20 piano wire, *ca.* 1 mm. in diameter); the metal of this wire is, however, not homogeneous; in particular it was always found that freshly cut and slightly used wires were decidedly more sensitive to activation than wires which had been used for some time and in which the outer layer had been dissolved away. Apparently the surface-layer of a drawn wire is less homogeneous than the core, and hence forms a less uniform and stable passivating surface-film. To obviate this source of irregularity, in the following experiments wires were used which had been reduced by the acid to two thirds or less of the original diameter. Such wires when passivated exhibit a relatively uniform behavior in salt solutions, although in the more slowly activating solutions the exact time required for activation still shows considerable variation. This variability has probably the same basis as the variability in the rusting properties of different specimens of iron. In each trial of a particular solution in any series of experiments several independent determinations with different wires are therefore necessary; as a rule these show good agreement, with occasional well-marked variations, due presumably to accidental variations of structure or composition in the exposed surface of the metal.

Halides.—Solutions of metallic chlorides, including those of noble metals (Hg, Au, Pt), activate passive iron with great rapidity. The following series of experiments with four chlorides are typical and illustrate the dependence of time of activation upon concentration; they also show the relative unimportance of the cation in such solutions. In each solution seven trials with seven separate wires were made with each length of exposure; time was marked by a metronome; the wires were transferred by glass hooks from the distilled water to the tubes containing the solutions. The time given is the usual minimal exposure required to render the passive wire reactive to dilute HNO_3; with briefer exposures the wires remain passive.

[1] Passive wires retain their passivity in distilled water for a considerable period—ranging in various experiments from 15 to 23 minutes at room temperature—but not indefinitely, a fact again indicating that the passive state is preserved only when there is the possibility of continued rapid oxidation.

Conc.	NaCl	KCl	$CaCl_2$	HCl
m/50	ca. 1 sec.	ca. 1 sec.	ca. 1 sec.	ca. 1 sec.
m/100	1 to 2 "	1 to 2 "	ca. 1 "	1 to 2 "
m/200	3 "	ca. 3 "		
m/400	4 to 5 "	ca. 5 "	2 "	4 to 5 "
m/800	ca. 6 "	10 "	4 to 5 "	
m/1,000				10 to 12 "
m/1,200	ca. 10 "		ca. 8 "	
m/1,600		16 "		

These series were carried out at different times and with different wires, and the results are not strictly comparable. In general, however, the rate of the activating process, in the case of each salt, is approximately proportional to the concentration. A progressive alteration of the surface-film, at a rate determined by the concentration of Cl-ions, appears to underlie the effect. With the above chlorides the nature of the cation seems indifferent; but with the chlorides of noble metals a retarding influence of the cation is apparent; thus *m*/4 $HgCl_2$ required 2 to 3 seconds for activation and *m*/8 $HgCl_2$ 3 to 4 seconds. A comparison of the three chief halides showed a decreasing velocity of activation in the order, Cl, Br, I; in *m*/50 solution the minimal times for activation were: NaCl, 1 to 2 seconds; NaBr, 3 to 4 seconds; NaI, 12 to 14 seconds.

Other Salts.—Activation occurs much more gradually in solutions of other salts. The following results are typical for the minimal activating exposures in *m*/2 solutions of sodium salts:

NaOH	10 to 30 seconds
Na_2CO_3	2 to 4 minutes
Na_2SO_4	1 to 10 minutes
Na_2HPO_4	3 to 5 minutes
Na-acetate	30 sec. to 4 min.
Na-tartrate	2 to 4 minutes
Na-citrate	5 to 10 minutes
$NaNO_3$	5 to 20 minutes
$NaClO_3$	2 to 30 minutes
NaCN	5 to 7 minutes

The figures given represent the extremes of different observations with wires of varying sensitivity. Passivity is preserved longest in solutions of nitrates and chlorates, but all salts with terminal oxygen in the anion activate slowly. Why cyanide should act similarly is difficult to say; the whole subject should be investigated thoroughly. It is noteworthy that in nitrate solutions no definite relation between concentration and velocity of activation was found; in all of the solutions examined activity appeared only after the lapse of several minutes; and apparently its precise moment of appearance depends largely on casual conditions, especially irregularities in the structure of the metal. The following list gives the minimal times of exposure observed in a series of solutions of $NaNO_3$.

Conc.	Active after
m	10 minutes
m/2	4 "
m/4	8 "
m/8	> 10 "
m/16	10 "
m/32	6 "
m/64	6½ "
m/128	4 "
m/256	> 8 "
m/512	6 "

In this series the least effective exposure was 4 minutes, and there was no apparent relation to concentration. Not infrequently wires have been found passive after 15 or 20 minutes in solutions of $NaNO_3$. In all probability the structural conditions at the surface of the metal, which in such experiments are determined by casual conditions beyond control, are a main factor determining the precise rate of activation in any instance. An analogy is offered by the case of rusting, the rate of which depends not so much upon the concentration of oxygen and the conductivity of the solution as upon the special character of the metal; this determines the number of local couples to whose electrolytic action the chemical change is chiefly due. Pure and homogeneous specimens of iron rust very slowly, even under the most favorable conditions.[1]

In the above solutions the delay in activa-

[1] *Cf.* Walker, Cederholm and Bent, *Jour. Amer. Chem. Soc.*, 1907, Vol. 29, p. 1251; Lambert, *Jour. Chem. Soc.*, 1910, Vol. 97, *Trans.*, p. 2426, and 1912, Vol. 101, p. 2056; Dunstan and Hill, *ibid.*, 1912, Vol. 99, p. 1835.

tion depends upon the oxidizing properties of the anion. In solutions of alkali salts with anions of still greater oxidizing power, *e. g.*, bichromates and permanganates, passivity is preserved indefinitely. These salts, as well known, are strong passivating agents; a saturated solution of $KMnO_4$ passivates active iron wires with one or two seconds exposure or even less.

The nature of the cation is also an important factor in the activating or passivating action of a salt. Passive wires retain their passivity longer in solutions of heavy metal salts (especially nitrates) than in corresponding solutions of alkali and alkali earth salts. This is well illustrated by copper salts; in $m/20$ $CuCl_2$ activation is rapid (1 to 2 seconds), as in all solutions of chlorides; in $m/20$ $CuSO_4$ it usually requires from 5 to 10 minutes, and in $m/20$ $Cu(NO_3)_2$ more than 30 minutes. A similar relation is seen with acids; $m/10$ HCl activates in less than 1 second; $m/10$ H_2SO_4 requires several minutes; while in $m/10$ HNO_3 passivity is preserved indefinitely. The nitrates of metals with a lower solution-tension than passive iron ($AgNO_3$, $Hg(NO_3)_2$) also preserve passivity indefinitely and their solutions act as strong passivating agents.

In solutions of copper salts the precise activation-time can be measured with accuracy in a single wire if the wire is kept under close observation, for at the moment when activation is complete metallic copper begins to be deposited upon the bright surface of the iron and in a few seconds the original steel-white luster changes to a dull copper-red. A large number of observations have been made on the influence of different conditions (especially presence of organic compounds, oxidizing agents, and salts of noble metals) upon the rate of activation in $m/20$ $CuSO_4$ and $Cu(NO_3)_2$; in such mixed solutions antagonism-effects are well-marked and will be described below.

An interesting feature in the behavior of passive wires in these solutions is that activation (involving as it does the deposition of copper on the iron surface) has a marked influence upon the subsequent behavior of the same wire when it is repassivated and returned to the same solution. Unless the copper coating is removed very completely from such a wire before repassivation, the latter is always found to be distinctly more reactive in the copper salt solution than before, *i. e.*, activation occurs in a much shorter time. My usual procedure in repassivating wires after activation in solutions of copper salts has been to dissolve off the adhering copper with dilute HNO_3 and then wipe the wire carefully with a coarse cloth until everywhere bright and clean before placing in strong HNO_3 for repassivation. But if the copper is imperfectly removed before repassivation (*e. g.*, by simply rubbing the wire with the cloth), and especially if the stay in strong acid is brief, the wire is typically found to become active in the salt-solution within a briefer period than normally. Thus with wires carefully cleaned before passivation, the average time of activation in $m/20$ $CuSO_4$, with 36 trials with different wires, was 11 minutes; while with wires which were passivated with some copper still adhering the average of 31 trials was 3 minutes. In $m/20$ $Cu(NO_3)_2$ the respective times were: carefully cleaned wires, 34.2 minutes; imperfectly cleaned wires, 19.7 minutes (average of 20 trials in each case). Although the two sets of wires have the typical steel luster after passivation and are then indistinguishable in appearance, it is probable that the sensitizing effect of the previous activation is to be referred to the presence of minute particles of copper which remain adhering to the surface of the iron and by acting as anodal regions or nuclei exert upon the general film-covered surface an influence favorable to activation. Under normal conditions the contact of metallic copper activates passive iron; presumably, therefore, the presence of this adhering copper would have the same influence in promoting activation as the simultaneous contact of numerous particles of the metal at different points of the surface; the activation-process is facilitated and occupies a shorter time than before. Activation in a solution of a copper salt thus renders the metal for a time more sensitive to a second

activation—a condition which has many general biological analogies and suggests that the basis for many phenomena of sensitization and memory in organisms may consist in a deposition of specific materials in the surface-films of the sensitive elements. In other words, some specific and lasting change in composition is the direct result of the response to stimulation, and increases the sensitivity to a subsequent stimulation of the same kind.

Antagonisms.—In general any condition that confers increased stability upon the surface-film prevents or retards its destruction in an activating solution and hence preserves passivity. Accordingly strongly oxidizing compounds like peroxides, bichromates, permanganates, osmium tetroxide, salts of noble metals (Hg, Ag, Au, Pt) antagonize the activating effects of sodium nitrate and other salt solutions upon passive iron. The addition of one mol of $AgNO_3$ to 100 mols of $NaNO_3$ in a solution of the latter salt entirely prevents spontaneous activation. The antagonism between Na and Ca salts, however, which is so characteristic of biological systems, is not exhibited by passive iron, or only slightly. It is also difficult to antagonize the activating effect of chlorides; for example, in $m/60$ NaCl the addition of $K_2Cr_2O_7$ to a total concentration of 0.08 m. was found to preserve passivity indefinitely, but 0.04 m. proved insufficient, although it prolonged the time of activation from one or two seconds (the time in pure $m/60$ NaCl) to about 30 seconds.

The activating influence of the Cl-ion is thus counteracted only by a great excess of the oxidizing agent. A less strongly oxidizing salt like $NaNO_3$ has only a slight antagonizing effect with chlorides; thus in a series of mixtures of $m/50$ NaCl and $m/50$ $NaNO_3$ in all proportions, using passive wires which underwent activation in pure $m/50$ NaCl in 2 to 3 seconds, the activation-time was prolonged to only 7 or 8 seconds in a solution containing 1 part NaCl to 4 parts $NaNO_3$, and to 20 or 25 seconds in a solution of 1 part NaCl to 9 parts $NaNO_3$. In the pure $m/50$ $NaNO_3$ activation requires five minutes or more. The prepotent action of the Cl-ion is thus evident.

The action of $AgNO_3$ in solutions of sodium nitrate, chlorate, sulphate or acetate affords a typical instance of ion-antagonism in which the protective effect is due to the cation of the added salt. Many biological antagonisms are of this class. The following brief summary of typical experiments will illustrate. Passive wires were placed in solutions of the four sodium salts named, both pure and with the addition of $AgNO_3$ as indicated.

Solution	Result
Pure $m/10$ $NaNO_3$, $NaClO_3$, Na_2SO_4, or $NaOOCH_3$	Wires are all active within 30 minutes or less.
99 vols. $m/10$ Na-salt *plus* 1 vol. $m/10$ $AgNO_3$	Wires in $NaNO_3$, Na_2SO_4 and $NaOOOCH_3$ remained passive indefinitely; in $NaClO_3$ they became active in respectively 1 hour, 2½ hours, and 50 minutes in three successive trials.
98, 97 96 and 95 vols. $m/10$ Na-salt *plus* (respectively) 2, 3, 4 and 5 vols. $m/10$ $AgNO_3$	All wires remained passive indefinitely.

Salts of other noble metals (Hg, Au, Pt) similarly prevent spontaneous activation in solutions of $NaNO_3$. Of the two mercuric salts, chloride and nitrate, the former proved ineffective in the three mixed solutions used, viz., 95, 90 and 80 vols, $m/10$ $NaNO_3$ *plus* (respectively) 5, 10 and 20 vols. $m/10$ $HgCl_2$; in these solutions the action of the Cl-ions overbalances that of the Hg-ions; but in corresponding solutions containing $Hg(NO_3)_2$ instead of $HgCl_2$ passivity was preserved indefinitely. Similarly a slight addition of $AuCl_3$ or $PtCl_4$ to $m/10$ $NaNO_3$ prevented spontaneous activation and preserved passivity indefinitely (*e. g.*, 2 or 4 c.c. of a 1 per cent. solution of either salt to 100 c.c. of $m/10$ $NaNO_3$).

It is significant that such salts exhibit protective action only if the metal is nobler than passive iron; similar addition of $Ca(NO_3)_2$, $Pb(NO_3)_2$ or $Cu(NO_3)_2$ to $m/10$ $NoNO_3$ had no such effect. Apparently the metal of the

antagonizing salt must be of such a nature that its contact (as metal) with passive iron promotes passivity rather than activity; thus it is well known that contact of passive iron with copper, lead and other baser metals causes activation, while contact with mercury and the nobler metals has no such effect and indeed promotes passivity. Hence any metallic particles of the former class which may be deposited on the iron surface serve as activating centers (*i. e.*, are anodic relatively to passive iron), while those of the latter class have a reverse or passivating influence. The ability of any cation to prevent activation thus depends upon the electrical potential of the metal in relation to that of the passive iron surface. In other words, the passivating effect is a direct function of the oxidizing potential of the ion in question, *i. e.*, the readiness with which it parts with its positive charge (or receives electrons).

As already shown, the activating effect of the $NaNO_3$ solution is equally well prevented by the addition of small quantities of salts with strongly oxidizing anions, like $K_2Cr_2O_7$ or $KMnO_4$; oxidizing non-electrolytes like H_2O_2 and OsO_4 have a similar influence. Ionic antagonism is thus not a function of the sign of the ionic charge, but of the special chemical—more specifically oxidizing—properties of the ion. Non-electrolytes with similar chemical properties are equally effective. All of these phenomena have parallels in the behavior of living systems.

Pure solutions of $AgNO_3$, $Hg(NO_3)_2$, $K_2Cr_2O_7$ and $KMnO_4$ both preserve passivity and have a rapid passivating action on active iron. An exposure of two or three seconds to $m/20$ $AgNO_3$ or $Hg(NO_3)_2$ is sufficient to confer passivity upon an active wire. The velocity of the passivation-process is high; in a series of experiments with solutions of $AgNO_3$ ($m/10$, $m/20$, $m/40$, $m/80$, $m/160$) it was found that even in the $m/160$ solution an exposure of three seconds was usually sufficient for passivation. Saturated $KMnO_4$ passivates with exposures of one second or less; $K_2Cr_2O_7$ is somewhat slower in its action.

The essential results of experiments with surface-active organic compounds (anæsthetics) can be summarized briefly. $m/20$ $CuSO_4$ was used, containing in solution the compound under examination; the rate of activation was compared with that observed in the pure $m/20$ $CuSO_4$. In general such compounds, unless of a definitely oxidizing chemical character (*e. g.*, nitro compounds or nitrate esters), exhibited little or no effect in either retarding or accelerating activation. The higher aliphatic alcohols, however (n-hexyl, n-heptyl, n-octyl, capryl), had a moderate retarding influence in saturated solution, an effect probably dependent on the viscosity of the adsorbed layer and the lowered electrical conductivity; little effect was found with the lower members of the series. Chloroform, ethyl ether, carbon tetrachloride, ethyl and phenyl urethanes, fatty acid esters (ethyl acetate, propionate and butyrate), chloretone, paraldehyde, chloral hydrate, benzol, naphthalene, phenanthrene, all showed little or no retarding action. On the other hand, ethyl nitrate had a well marked antagonistic effect, in one case prolonging passivity for more than twenty-four hours; nitromethane and acetonitrile also caused distinct retardation. Parallels with the general pharmacological action of the above compounds are thus not apparent in these experiments, but the existence of such parallels is perhaps hardly to be expected. In the living cell the characteristic action of these compounds appears to depend largely upon solution in the organic solvents of the protoplasm, especially the lipoids; the stability of the protoplasmic film is correspondingly altered, being increased at the anæsthetizing concentrations of the compounds. In the metal no such process of solution can occur, and whatever influence is exerted appears to depend upon the physical properties of the adsorbed layer or upon the direct chemical action of the compound upon the metal.

RALPH S. LILLIE

PHILADELPHIA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE general description of the meeting held September 2 to 6, 1919, has already been printed

in SCIENCE, for September 19. The following is a list of the papers with abstracts in so far as they have been obtained:

GENERAL MEETING

Some problems and methods in agricultural research: H. J. WHEELER.

Some physiological effects produced by radiating definite regions within a single cell: W. V. BOVIE.

Stream pollution and its relation to the chemical industries: EARLE B. PHELPS. Published in full in *Jour. Ind. and Eng. Chem.*, 10 (1919), 928. The relation of stream pollution to the chemical industries is two-fold. Many industries require water supplies of good quality, and most of them produce liquid wastes which, if discharged without treatment into the water courses, tend to pollute those waters. With the growth of industry, and the increasing joint use of streams for the purposes of water supply and waste disposal conflicts of interest are bound to arise.

In most states this matter comes under the administrative activity of the public health officials, who likewise initiate or assist in framing the laws. Manufacturing interests have in the past exerted merely obstructive influence.

Stream pollution and its control involve problems of engineering, chemistry, biology and economics. The first aim is the fixing of standards of permissible pollution which will develop the maximum advantageous use of the streams.

The subject of treatment presents many interesting chemical problems, and its study frequently leads to important recoveries of by-products.

The subject of stream pollution and its control is broader than its legal and remedial phases; its public-health interests or its manufacturing interests; its broader than state jurisdictions. It is a part of the problem of the maximum utilization and development of our waterways. As such it is essentially a Federal problem, calling for extensive investigation and uniform treatment. Its importance should be fully recognized in the creation of any such federal commission as the Interstate Waterways Commission which has recently been suggested.

The building of atoms and the periodic systems: W. D. HARKINS. (To be printed in SCIENCE.)

The chemical laboratory as a publicity factor: ROBERT P. FISCHELIS. See *Jour. Ind and Eng. Chem.*, 10 (1919), 929.

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

W. D. Richardson, *Chairman.*

T. J. Bryan, *Secretary.*

What was the diet of aboriginal man? W. D. RICHARDSON.

On the constitution of butterfat: W. D. RICHARDSON.

Some experiments on simple dietaries: W. D. RICHARDSON.

Influence of segregation upon the composition of sugar products: C. A. BROWNE. The author after a brief mention of the uneven distribution of the constituents of different sugar products, such as honey, sirup, sugars, jelly, etc., produced by gravity, capillarity, evaporation and other causes, cites the specific instance of low grade molasses. Top and bottom portions of Cuban molasses, which gave no visible indications of deposits, showed from 2.50 per cent. to nearly 4 per cent. more ash and from 0.25 per cent. to 1.40 per cent. more organic non-sugars in the bottom layers. Similar but less pronounced differences were observed in case of refinery molasses. As a result of the settling out of insoluble salts and gums the top portions of unmixed molasses may be expected to contain more water, sucrose and invert sugar than the bottom portions.

The hydroscopic capacity of certain food constituents: C. A. BROWNE. The moisture-absorbing capacity of levulose agar, gelatin, peptone, bread, cellulose and sucrose are given for different conditions of atmospheric humidity. For ordinary conditions the power of the substances to absorb moisture decreases in the order named. As regards influence of season food products have the least moisture in February and the highest moisture in July and August. The ratio of moisture content to humidity and the influence of lag (due to time of adjustment between surface and interior moisture) are discussed. The rates of absorption for the different substances under constant humidity are given, also a few practical bearings which the results have upon commercial and analytical problems.

The relative importance of some coloring matters in sugar cane juices and syrups: F. W. ZERBAN.

Nutrition experiments with low-cost protein diets with reference to the utilization of peanut and soy bean flours: CARL O. JOHNS, A. J. FINKS and MABEL S. PAUL.

The amount and distribution of iron in the corn plant: G. N. HOFFER, R. H. CARR and I. L. BALDWIN.

Chemical changes in cranberries during storage: FRED. W. MORSE. There are small but positive differences in the percentages of sugar and acid contained in different varieties of cranberries. The maximum of sugar is present soon after picking. During storage the sugar slowly diminishes as the berry makes use of it in maintaining its life processes. The rate of change is much accelerated by a rise in temperature and is most pronounced when the fruit is kept in tight, unventilated packages. Acid remains as a rule unchanged.

Respiration of cranberries: FRED W. MORSE. A simple method of estimating the rate of chemical changes in fruit at a given temperature, is to determine the amount of CO_2 exhaled by a kilogram of the fruit in an hour. The CO_2 is produced by the oxidation of some of the soluble carbonaceous matter in the fruit's cells, hence the rate of metabolism may be closely estimated. The experiments showed that cranberries exhaled twice as much CO_2 at 10° C. as at 1° and that the rate doubled again at 20°. The nearer the freezing-point, fruits are held before they are consumed, the more nearly will their quality remain like freshly picked fruit. A week at summer temperature will be as destructive to quality as a month in cold storage.

The cause of deterioration and spoiling of corn and corn meal: J. S. MCHARGUE.

The water soluble manganese of soils: W. O. ROBINSON, R. F. GARDINER and R. S. HOLMES. The results obtained by frequently shaking 24 samples of soil with distilled water for eight days are given in this paper.

The following deductions are drawn from the data: (1) One hundredth to .1 of the total manganese of soils is soluble in water. (2) Carbon dioxide greatly increases the solubility of the manganese. (3) Surface soils contain much more soluble manganese than subsoils, the difference is greater the finer the texture of the soil. (4) The amount of MnO in soil extracts varies from 0–24 parts per million and is large enough to affect the bacteriological flora and probably has a more direct influence on plant growth.

The composition of ultra clay from certain soils: W. O. ROBINSON. By the term "ultra clay" is meant that body which remains in nearly permanent suspension when the soil is treated with pure water. It has no organized structure and behaves as any colloid. It is essentially an extremely finely divided hydrous aluminum silicate, with some of the aluminum replaced by iron. Hydrated oxides of aluminum, iron, titanium, silicon and manganese (probably) are also present. The phosphoric acid and potash of ultra clays is higher than the soil from which they were obtained. Organic matter is an ever present constituent and it is probable that it plays an important part in deflocculating the suspension.

Composition of soil extracts: M. S. ANDERSON and W. H. FRY. The salts deposited on the evaporation of the water extract of soils are much more complex in character than is indicated by a simple statement of the ions existing in solution. There is a marked general similarity between the salts obtained on evaporation of water extracts of soils and those obtained by both natural and artificial evaporation of sea-water. No salt can be expected to furnish all the salts occurring in natural deposits of saline material because these represent crystallization from a composite extract. Under ordinary soil conditions these complex salts are probably always in solution in the soil moisture.

Melezitose in honey: EDGAR T. WHERRY. Melezitose is a rare sugar, a trisaccharide, which has heretofore been but little known. Its name is from melez, the French name for the larch tree, it having been discovered in a honey dew on the European larch. It also occurs in manna, a sugary incrustation, on a leguminous tree in Persia and adjoining countries. Its occurrence in a similar material found on the Douglas fir in British Columbia has been recently described by Hudson and Sherwood.[1] While the latter occurrence was under investigation, some honey received from central Pennsylvania was found to be nearly solid from the crystallization of the same sugar; and Dr. C. S. Hudson asked the writer to visit the regions where this honey was produced, and endeavor to ascertain the origin of the melezitose. After considerable study, the following origin of this substance was worked out: The scrub pine tree, and rarely other species of pine, are subject to attack by a plant louse—of the group known technically as lachnids—and a scale insect of the group known as coccids. These insects develop in midsummer in considerable numbers, and in the course of their life activities excrete a sweet material, honey-dew, which is rich in melezitose. In dry summers, after the white clover flowers have ceased to yield honey, the bees turn to this honey dew, and collect it, but it crystallizes as fast as they store it away,

[1] *J. Am. Chem. Soc.*, 40, 1456 (1919).

making the honey unattractive in appearance, and if stored in cells to be used by the bees during the winter, disastrous to the bee keepers; for during the cold weather the bees can not get water to dissolve the crystals, and starve. This occurred in 1917 and 1918, and considerable losses were suffered by the bee-keepers from this cause. But in the present year the weather was so moist during July that no melezitose was collected by the bees at all. Several kilograms of this rare sugar have been extracted from honey and purified in the Bureau of Chemistry, so that it is now available for thorough investigation of its properties. It can be readily distinguished from glucose by observation of the crystals in the honey with the polarizing microscope.

Milk with high apparent acidity: Frank E. Rice. Individual cows were found giving milk with titratable acidities as high as .22 per cent. Several tests were applied to this type of milk as well as to normal milk both fresh and sour. The results were as follows: (1) Formaldehyde titration indicated that where high casein was present, high apparent acidity might be expected. On the other hand, some samples were found with high apparent acidity which were not unusually high in casein. (2) Titration by the Van Slyke oxalate procedure indicated that phosphates were always somewhat higher in this class of milk. (3) Electrometric and colorimetric methods showed the hydrogen ion concentration to be similar to that of normal fresh milk. (4) Electrical conductivity was no higher than in normal milk. (5) Methylene blue and alcohol tests were always negative. (6) High solids and solids-not-fat usually but not always accompanied high apparent acidity. (7) This condition was always found in the early stages of lactation but occasionally also in late stages. (8) Observation did not indicate that feeds were a factor in causing high apparent acidity.

Effects of sulphur in manure-phosphate composts: W. E. Tottingham. Sulphur and rock-phosphate have been composted with manure, both separately and together. Analysis after four months of fermentation has shown the production of high titratable acidity where sulphur was present, with consequent increases of citrate-soluble P_2O_5 where rock-phosphate was also present. Application of these composts to pure sand, together with nutrient salts, to sandy soil and to silt loam for greenhouse cultures of barley has led to increased yields of seed from the sulphur-phosphate compost, as compared with the compost of phosphate alone. Similar results have followed the application of sulphur and rock phosphate to field plots of barley in unmanured sandy loam. The peculiar, outstanding feature of the results has been that sulphur alone has shown as great seed producing power as the combination of sulphur with rock-phosphate, under these conditions.

The quantities of preservatives necessary to inhibit and prevent alcoholic fermentation and the growth of molds: Margaret C. Perry and George D. Beal. Sterile dextrose broth, to which known quantities of preservative had been added, were inoculated with pure cultures of *Sacc. cerevisiæ* and *P. glaucum*. The tubes were incubated at room temperature until positive results were obtained in check tubes. In case of no gas formation or of failure to obtain a visible growth of mold, dextrose agar plates were poured to determine the point at which complete sterilization took place.

Shark meat as an edible product: Allen Rogers. This paper deals with the use of shark meat as a food product and shows that it would be possible to secure approximately 200,000 pounds of this material daily or 75,000,000 pounds annually. Assuming that the market price could be set at 10 cents it shows that at the present time we are wasting a food product with a value of $7,300,000. The edible portion of the shark consists of about 50 per cent. of the weight of the body and resembles in its texture and flavor either the halibut or sword fish. In some markets this product is now being sold under the name of deep sea sword fish and a certain species of shark known as dog fish is being canned and labelled grey fish. Cooking experiments have shown the food to be very palatable and nourishing.

Charles L. Parsons,
Secretary

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CONTENTS

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A SYSTEM OF COOPERATION BETWEEN THE COLLEGE AND INDUSTRY

Much has been written in recent months pointing out in unmistakable terms the value of chemical research to industrial companies and organizations. There has been described an enormous number of problems within the range of chemistry and chemical engineering, which are at present confronting the industrial world or which, by their solution, would vastly enhance the efficiency of their processes or the marketability of their products.[1] Many papers have discussed the methods by which such investigational work might be introduced; some going into much detail as to the establishment of departments of chemical research within the industrial plants themselves,[2] and others revealing the advantages which would obtain by causing these several investigations to be studied in centralized laboratories of industrial Research.[3] Still others have pointed out the advantages to the industrial organizations of permitting

[1] Duncan, "The Chemistry of Commerce," *No. Amer. Rev.* (1907), 241, and "Some Chemical Problems of To-day," *ibid.* (1911), 224. Hamor, "The Value of Industrial Research," *Scientific Monthly*, 1–86 (1915), and "The Research Couplet," *ibid.*, 6–319 (1917). Bacon, "The Remuneration of Industry by Research," *Sci. Am.*, 116–281 (1917). Bacon and Hamor, "Some Present-day Problems of Chemical Industry," *J. Ind. Eng. Chem.*, 11, 470 (1919).

[2] Mees, "Planning a Research Laboratory for and Industry," *J. Ind. Eng. Chem.*, 10, 476 (1918).

[3] Bacon, "The Industrial Fellowships of the Mellon Institute," *ibid.*, 11, 371 (1919). Symposium on "An Institute for Cooperative Research as an Aid to the American Drug Industry," *ibid.*, 11, 59; 11, 157; 11, 377 (1919). Annual Report of the Honorary Advisory Council for Scientific and Industrial Research of Canada, March 31, 1919, Canadian Official Record, August 7, 1919.

some of their perplexities to be investigated within the laboratories of the college and the university.[4]

It is not the purpose of this paper to elaborate upon any of these proposed methods for the solution of the chemical research problem, nor to suggest any new solution, but rather to discuss a phase of the situation upon which but little has been said, *e. g.*, the advantages which may be derived by the college or university itself by the establishment within its department of chemistry of a coöperative system of industrial research.

It is of too common occurrence to be longer neglected that many unfortunate "diseases" are frequently encountered in the small college and university chemistry department. The members of the staff are too often fearfully overworked, and this results not only in lowering their our physical well-being and mental repose, which reflects only too plainly in the quality of the work they present to their classes, but may even result in the presentation of courses by a plan which is an imposition to the student and a discreditable reflection upon the institution.

Investigational work is often, very often, entirely excluded from the program of the instructing staff. This may be because of a lack of time, or it may be the result of indifference, but whatever the cause it is a most serious mistake. Investigational work is the one thing which is able to keep a teacher from becoming "stale" and falling into the otherwise almost inevitable "rut." A few of the leading universities in the country have set the excellent precedent of not only permitting each instructor time in which to do research but actually expecting him to do this and determining his rating to a certain extent upon his ability at research.

We often find students in their junior or senior years assisting in the instruction work in the freshman and sophomore laboratories. It is evidently necessary to do this or else to go without such assistance entirely, but it is far from being a satisfactory arrangement. The professor is not greatly benefited, as he is obliged to keep a very close supervision over these assistants and often correct their mistakes, and the students usually fail to accept them as much more than a joke.

The average college is usually desirous of obtaining men to become candidates for advanced degrees. This is not only justifiable ambition but sound business, for on the average the men who go farthest in their study of a science while attending college as graduate students are the men who later become the recognized authorities in their respective departments. But the average college has difficulty in obtaining even a sufficient number of candidates for post-graduate work to take care of the college assistant work that is desired.

Again, many a good man would like to take advanced degree work but can not find the funds. For even if he is granted an assistantship it seldom pays more than $300 to $400 per year, and this is insufficient for a living. If it were made $800 many more men would be attracted to the work.

Even the salaries of the professors themselves are often pitifully inadequate, and it becomes almost a necessity for the staff members to accept work, analytical usually, from extraneous sources in order to obtain a reasonable living income. It is evident that such work is undertaken only at the expense of the already oppressed college courses and belabored professors.

As a means of remedying some of the difficulties presented above, a properly directed system of cooperation between the college and industry has great possibilities. Such a system may be briefly drawn as follows: That industrial companies and associations shall be solicited to present their chemical problems to the college for solution.

That in consideration of a specified stipend to be paid in advance by the company or association to the college, the latter will undertake through its department of chemistry to solve such problems as may at the time be presented.

[4] "Post Doctorate Fellowships," *J. Ind. Eng. Chem.*, 11, 278 (1919). "Report of the Committee on Cooperation between the Universities and the Industries," *ibid.*, 11, 417 (1919).

That the department of chemistry will assign a "fellow," who shall have received his bachelor's degree, to the problem; this fellow to devote from half to full time to the problem and the balance to assistant work in the department of chemistry.

That the fellow shall be paid (about) $800 per year to be drawn from the "fellowship" fund and the college funds in proportion to the amount of time he shall spend on each.

That the work of the fellowship shall be considered as legitimate material upon recommendation of the department staff for a thesis for the degree of Master of Science, and in special cases for the degree of Doctor of Philosophy, the fellow having completed the other requisite requirements as of credits, languages, residence, etc.

That (about) 10 per cent. of the fellowship fund shall be set aside for equipment, chemicals, traveling expenses, etc.

That the several problems presented shall be under the immediate direction of the department member who represents that branch of the science, or of a director of industrial research and head of the division of industrial chemistry.

That the regular salary of each department member who has fellowships under his supervision shall be augmented by a specified sum to be drawn from the fellowship fund.

That fellows engaged upon industrial problems shall not be charged laboratory fees, or breakage fees, nor shall there be any charges relative to their procurement of any advanced degree.

That department members will not accept any personal propositions which might legitimately become a department fellowship.

The scheme as developed should relieve much of the aforementioned difficulties and "diseases."

The higher salary paid assistants would create a demand and a competition among men for the positions. High-class men may be selected. These men, being holders of at least the bachelor's degree, will be available for assistant work of a high order, such as will relieve the professors of a vast amount of responsibility and time spent in the laboratory and in preparation. This alone would often cut half of the time from the professor's schedule, thus enabling him to improve his courses by giving them the proper amount of reflection and applying with deliberation the principles of pedagogy.

It will provide a suitable source of outlet for the research needs of the professor, inasmuch as he is to be the director of several fellowships. The responsibility for their success will rest primarily upon his shoulders, although the major portion of the laboratory work connected with them will be performed by others. He will thus have incentive to keep "alive," and the spirit of competition and production and contact with the outside world of industry will make him more keenly appreciative of his function as a teacher of a coming generation of chemists.

The college will be granting advanced degrees yearly to its fellows, and these are bound to create a reputation for the college in their respective fields of investigation which will make for its recognition and success.

The increase in the department personnel due to many assistants will decrease the work and responsibility of each professor, thus providing the time in which he may study and work upon his fellowship problems, and his salary will be justly augmented by inspiring work performed in working hours rather than by depressing analytical procedures performed at night or at the expense of college courses. He will not then feel the need of an apology for the profession of his choice. In brief, the college and its teaching staff in chemistry will have much to gain and nothing to lose by the adoption of a system of cooperation with industry in chemical research.

Robert H. Bogue

Pittsburgh, Pa.

THE DIGESTIBILITY OF THE BRANNY COATS OF WHEAT

There is one phase of the recurrent subject of the digestibility of flours containing more or less of the branny portion of wheat that has not been brought out in the dis-

cussion of recent digestion experiments on bran either by Holmes[1] or Snyder.[2]

It is a matter of regret that Holmes did not make, or at least did not publish, the proximate analysis of the bran used in his digestion experiments. The bran is merely described as "an ordinary commercial wheat bran secured in the open market."

For the purpose of this study then we may divide the wheat berry into three portions: The germ or embryo, the branny covering and the flour cells. The branny covering includes several outer and middle layers and the inner layer termed the aleurone layer. The aleurone layer or so-called gluten cells contains proteins apparently in higher amount than the outer layers, but the gluten cells do not possess the properties of, nor take part in the formation of gluten. Hence, although functionally the aleurone layer is a part of the endosperm and serves as a covering for the flour cells or so-called starch cells or floury portion, actually the physical property it possesses of close adherence to the outer coatings during the milling process, obliges us to consider it as simply one of the bran layers. Neither the bran coats nor the germ contains starch grains or those protein bodies which possess the same characteristics as the crude gluten obtained from the flour cells by the customary mechanical method of washing away the starch from a flour dough. Nevertheless commercial bran as obtained from all processes of milling at present employed contains considerable amounts of starch and gluten. The germ is, for the most part, recovered in the shorts or sometimes as a separate fairly pure product sold as "germ middlings." Bran manufactured by large well-equipped mills making use of the most improved bran dusting machinery is less "rich" than bran made by the average mill of smaller capacity. In other words, when the bran is closely "skinned" it contains less flour than "rich" bran. The flour present in bran exists both as loosely adhering but separate particles and unseparated masses of flour cells. No system of milling, however perfect, is at the present time capable of removing all the floury portions from the bran. Bran contains easily visible specks of flour, both free and adherent. Sometimes millers test the clean-up of their bran by rubbing it upon the coat sleeve or other piece of dark colored cloth. Commercial shorts contains still larger amounts of flour particles. White middlings, "red dog" and other "rich" feeds contain still more.

One of the tests which the cereal testing laboratory is frequently called upon to perform is the determination of the amount of flour present in bran, shorts and other by-products of flour milling. The method which we have generally used for this purpose is to determine the percentage of starch. On account of the presence in bran of considerable amounts of pentosans and other carbohydrates, the usual Sacchse method for starch determination is not applicable. The diastase method[3] is usually used for this purpose. Since wheat flour contains on the average about 70 per cent. of starch, the amount of floury material or potential flour present in a wheat by-product may be determined with a fair degree of accuracy by determining the amount of starch and multiplying by one hundred seventieths. Very few samples of bran have as low as 12 per cent. of flour. The average of some recent analyses of commercial brans gave 18.93 per cent. floury material. These may possibly not be representative, but the average amount of floury material in commercial bran will not be far from 15 per cent. and 30 per cent. floury material in commercial shorts is perhaps an average amount.

Consideration of the amounts of flour in average commercial bran will throw a little further light upon the subject of the digestibility of the branny coatings in the human stomach. Bearing in mind then the percentages of digestibility found by Holmes

[1] "Experiments on the Digestibility of Wheat Bran in a Diet without Wheat Flour," U. S. Department of Agriculture. Bulletin No. 751.

[2] SCIENCE, N. S., 50, August 8, 1919, pp. 130–132.

[3] U. S. Dept. of Agriculture, Bureau of Chemistry, Bulletin 107, p. 53.

with ordinary unground wheat bran, viz., for protein 28.0 per cent. and for carbohydrates 55.5 per cent. and the other quoted experiments on graham, whole wheat flours and straight flours where greater or less amounts of the branny coatings were present, it seems perfectly safe to assert that the digestibility of the combined branny coatings of the wheat berry is even lower than the figures quoted. If we may assume, for example, that average commercial bran contains 14 per cent. protein and consists of 15 per cent. flour cells and 85 per cent. branny coats and that average straight flour has 11.5 per cent. protein, 2.1 per cent. of the bran is flour protein and 11.9 per cent. bran protein. If it is fair to apply to the flour protein, the average coefficient of protein digestibility—90.9 per cent. found in white flour digestion experiments,[4] 1.91 per cent. of the bran is digested from the flour protein and since but 3.92 per cent. of the total protein is digested, the balance or 2.01 per cent. represents the digestible protein derived from the bran coats only. The digestibility of the protein of the branny covering of the wheat grain is therefore about 16.8 per cent.

In the absence of data on the digestibility of ground husks and pulverized nut shells, it is perhaps no exaggeration to assert that as far as the digestibility in the human stomach of the branny portion of the wheat grain is concerned, bran must be considered as not much more nutritious or desirable than pulverized nut shells would be.

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[4] Page 6, U. S. Dept. of Agriculture, Bulletin No. 751.

THE INTRODUCTORY COURSE IN ZOOLOGY

IT has been of especial interest to those of us in the University of Missouri who have taken part in the presentation of the introductory course in zoology to read the recent discussion in SCIENCE by Professor Bradley M. Davis[1] and Professor A. Franklin Shull,[2] because the type of course advocated by both is exactly the kind of elementary course that has been given here for nearly twenty years. It is, therefore, extremely gratifying to us to note the tendency that is beginning to manifest itself, as a result of the readjustment from war conditions, in respect to the introductory teaching of botany and zoology in our colleges and universities, and it is our earnest hope that it will not be long before the old type course will have been abandoned everywhere and its place taken by the more significant course based upon fundamental principles.

We have been attempting to do for a long time exactly what Professor Davis expresses as his hope for the future—"nothing more than the grounding of fundamental principles and a selection of information with rather definite reference to its general and practical interests, or its broad philosophical bearing," and Professor Shull's description of the first course in zoology, as it has been given in the University of Michigan for several years, applies in all essential respects to ours.

In no sense has our introductory course been one based upon the study of types, and never has it been dominated by anatomy. It has been our strong conviction that such a course fails utterly, from an educational point of view, in affording an adequate introduction to the study of zoological science. A thorough study of a single animal and studies in comparative morphology and in taxonomy belong, we have always held, to the more advanced and specialized courses designed for students who have an interest in the further pursuit of zoological knowledge, and not to the introductory course.

Long ago we recognized the obvious fact that the great majority of students who take our course in general zoology will receive no further biological training, and, therefore, our efforts have been directed toward giving it

[1] SCIENCE, N. S., Vol. 48, November 22, 1918, pp. 514–515.

[2] SCIENCE, N. S., Vol. 48, December 27, 1918, pp. 648–649.

significance as a factor in a general education. Throughout the course, the fundamental value of biological science to human welfare is emphasized, and no opportunity is lost to apply biological principles to the life of man. The broad, philosophical bearing of these principles is in no wise impaired by an appeal to practical interests, where such an appeal can be legitimately made.

This is the spirit behind the regulation of our college of arts and science which requires of all its students for graduation the introductory course in either botany or zoology. It seems self-evident to us that a type course does not and can not fulfill such a purpose.

General principles, not phyla and classes, furnish the *points d'appui* on which we attempt to build up both the lectures and the work of the laboratory. The animals that are used in the laboratory are studied not as representatives of groups, but rather as sample animals, convenient forms for observation and suitable for illustrating principles. Structure is never divorced from function in the instruction, and anatomical facts that fall within the scope of the course are not presented as of interest *per se*, but only as bearing upon general principles or as having some useful application.

The course is based upon the following fundamental aspects of zoological science, no one of which is unduly emphasized or slighted: (1) The organization of animals, both structural and functional; (2) the relation of animals to their environment, both general and specific (including economic considerations and relation of animals to disease); (3) the origin of the individual; and (4) the relation between successive generations of animals.

The several sections of the class are under the direction of different instructors, and each man is free to work out his own method of presentation of facts and their application to principles, but the final result and the spirit and the purpose of the course are the same throughout, although it may happen that the end is reached by somewhat different methods and arrangements of material.

The following outline, while not attempting to set forth details, fairly well represents the general scope and nature of our introductory course.

I. Introduction. *Lectures:* (1) Definitions; scope and position of zoology among the sciences; historical background of zoological science; (2) fundamental aspects of zoology; (3) protoplasm and its properties; (4) fundamental structure and functions of animals—the cell as the unit of structure and function.

II. The Organ-Systems and Their Functions. (A) *Lectures:* Based on the laboratory work on the frog, with reference, however, to other forms, including man; foods and the principles of nutrition are emphasized. (B) *Laboratory work:* The study of the organs of the frog and their functions, with numerous demonstrations and simple experiments. The concept of the animal as a cellular organism, as well as that of cell-differentiation, is built up through a study of tissues, both macerated and in section, of the frog and other animals.

III. Relations to Environment. (A) *Lectures:* General ecological relations; adaptations, behavior, etc., with special reference to the frog. (B) *Laboratory work:* Observations and experiments on the frog and other forms.

IV. The Protozoa. (A) *Lectures:* General characteristics; structure; functions, including reactions and reproduction; relations to environment; relation to disease. (B) *Laboratory work:* Study of *Amœba, Euglena, Paramœcium,* Gregarines; observations and experiments to illustrate general principles; demonstrations of pathogenic protozoa and other unicellular organisms.

V. Hydra. (A) *Lectures:* The study of *Hydra* as a simple metazoon and the beginning of cell-differentiation. Reproduction in the Cœlenterata. (B) *Laboratory work:* The study of *Hydra* and a hydroid colony. Demonstration of other Cœlenterates.

VI. Insects. (A) *Lectures:* Structure; life-histories; adaptations; habits and social relations; parasitism; insects as carriers of pathogenic organisms. (B) *Laboratory work:* The study of the grasshopper, and comparison with representatives of other orders. Numerous demonstrations illustrating protective coloration, mimicry, and other ecological re-

lations. Demonstrations of parasitic insects and other animal parasites, with explanation of relation to hosts.

VII. ONTOGENY. (A) *Lectures:* The general principles of reproduction and development. (B) *Laboratory work:* The study of the development of the frog, and comparison with other forms. Demonstrations of mitosis, germ-cells, chromosomes, fertilization; chick embryos and their nutritive mechanism; mammalian embryos and their relation to the placenta.

VIII. PRINCIPLES OF GENETICS. (A) *Lectures:* (1) Essentials of Mendelian heredity; (2) mechanism of heredity. (B) *Laboratory work:* Demonstrations of living and preserved material illustrating Mendelian principles.

IX. PRINCIPLES OF ORGANIC EVOLUTION. (A) *Lectures:* (1) Sources of evidence for evolutional change; (2) the method of evolution, with brief historical account and a discussion in the light of recent knowledge of the manner in which evolutional change takes place. (B) *Laboratory work:* Demonstrations of fluctuations, mutations, etc. Demonstrations of paleontological material, both fossils and models.

GEORGE LEFEVRE
UNIVERSITY OF MISSOURI,
COLUMBIA, MO.

SCIENTIFIC EVENTS

CHANGES IN THE FRENCH POPULATION IN 1918

THE minister of labor has completed the birth and mortality statistics for France for the year 1918. According to the Paris correspondent of the *Journal* of the American Medical Association the statistics show that the civil population of France decreased during the year 1918 by 389,575, not counting the war losses. The statistics, based on civil records, continue to cover only the seventy-seven departments that were not directly affected by military operations. This is the same as it was during the first four years of the war. It will be the same for the year 1919, and not until the beginning of 1920 will the statistics of all French territory, made complete by accession of Alsace and Lorraine, be included. If one compares the statistics of the years 1917 and 1918, for the seventy-seven departments of which account was taken, one will note that last year shows not only the persistance of an excess of deaths over births, but even an increase of the excess over that of the preceding year. In 1917, the population of the seventy-seven departments not invaded decreased 268,838, whereas the decrease in 1918 has risen to 389,575. This result is due to the considerable increase in the number of deaths during the second half of 1918, ascribable to the influenza epidemic; for the number of births showed a slight increase over 1917. A comparison of the statistics of the years 1917 and 1918 is given in the accompanying table:

	1918	1917
Births	399,041	343,310
Deaths	788,616	613,148
Excess of deaths over births	389,575	269,838
Marriages	177,872	158,508
Divorces	8,121	5,572

An analysis of the table reveals the fact that in 1918 there was: (1) an increase in the number of marriages; (2) a corresponding increase in the number of births, and (3) an increase in the number of deaths. This increase in mortality affects exclusively the second half of last year. During the first half of 1918, 316,077 deaths were recorded, as compared with 354,554 during the first half of 1917; and during the second half of 1918, 472,539 deaths were registered, as against 258,594 in 1917. According to the preceding figures, the number of civil victims claimed by the influenza last year may be placed at approximately 200,000.

A PUEBLO RUIN IN NEW MEXICO

THREE years ago Earl H. Morris, representing the American Museum of Natural History, undertook the excavation of an ancient Pueblo ruin in Astec, New Mexico. The work was begun at the suggestion and through the courtesy of the H. D. Abrams, the owner of the property, and is being financed from the Archer M. Huntington fund for surveying the southwestern United States. During the past month the museum party has uncovered a new section of the ruin revealing several rooms filled with sand and

fallen débris. These rooms were in perfect condition, just as left by the last occupants. The ceilings were standing and the objects left by the inhabitants scattered about on the floor. Nothing has disturbed them except the fine layer of dust sifted over all. One of the rooms had been filled to the ceiling and was found to be a burial room.

Mr. Morris writes:

In two second-story chambers there was a large accumulation of dry refuse. One of these yielded some excellent specimens of textiles and a burial with wrappings in a very good state of preservation. Above the refuse in the other room there was upon the fallen third floor a surprising number of stone implements, several bone tools, some beautifully worked wooden boards, seven coiled basket plaques (three well preserved), and a digging implement with handle of wood and blade of mountain sheep horn. In the refuse beneath this layer we have to date found the burials of five children (three with wrappings perfectly preserved), four baskets in excellent shape, a wooden dipper, some beads and various odds and ends. Three fourths of the deposit is still to be gone over. The outer covering of the wrapped bodies is particularly interesting. Each body was placed upon a rush mat. Then the sides were folded inward, and one doubled upward. The whole was then tied into a long package with cord or yuca strips. As yet I have not opened any of the bundles, so do not know what the interiors may contain besides the bones. These finds certainly are important. They are different from anything we have previously uncovered.

As a result of the excavations Aztec has become a popular resort for visitors. About 100 miles southwest of the Mesa Verde Park (in which the finest cliff-houses are to be found), and not over two hours' ride from Durango, Colorado, the ruin at Aztec is an attraction to all automobile tourists. During the present year more than 1,200 people visited the ruin.

THE AMERICAN CONGRESS OF SURGEONS

The ninth annual convention of the American Congress of Surgeons was held in New York City, beginning on October 20. War-time developments in surgery and the possibility of their adoption to industrial and civil practise were the principal topics for discussion.

More than 2,000 surgeons were present from all parts of the United States. Major General Sir Anthony Bowlby, who served as consulting surgeon to the British forces in France; and Sir Robert Jones, chief consulting surgeon and specialist in restoration of injured limbs at the army hospitals in France, England and Ireland, were present at the meeting.

The convention was opened by an address by Dr. J. S. Hill, of Bellows Falls, Vt., president of the congress. The remainder of the day's session was given over to technical discussions. Dr. William J. Mayo, of Rochester, Minn., delivered the inaugural address on the evening of October 20, the sessions continuing throughout the week.

A series of clinics covering every phase of modern surgery, another of afternoon meetings devoted to technical discussion of the morning's work, and a program of evening sessions, which, while arranged especially for surgeons, held much of direct interest to the general public were in progress during the week. The following program was presented:

PRESIDENTIAL MEETING, MONDAY

Address of welcome, Dr. J. Bentley Squier, New York, chairman of committee on arrangements.

Address of retiring president, Dr. John G. Clark, Philadelphia.

Inaugural address, Dr. William J. Mayo, Rochester, Minn.

Introduction of foreign guests, Sir Robert Jones, Liverpool; Major Gillies, R.A.M.C., Sidcup; Sir Anthony Bowlby, London.

Sir Anthony Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London: "Fractures of the femur." Discussion, F. N. G. Starr, M.D., Toronto.

TUESDAY

Dr. Harvey Cushing, Boston: "Brain tumor statistics." Discussion, Dr. Charles H. Frazier, Philadelphia; Dr. Allen B. Kanavel, Chicago; Dr. Charles A. Elsberg, New York.

Dr. Alexis V. Moschcowitz, New York: "Empyema; with particular reference to its pathogenesis and treatment." Discussion, Dr. John L. Yates, Milwaukee; Dr. James F. Mitchell, Washington.

WEDNESDAY

Sir Robert Jones, F.R.C.S., Liverpool, Eng.: "Stiff and flail joints." Discussion, Dr. Joseph A. Blake, New York; Dr. John L. Porter, Chicago; Dr. Joel E. Goldthwait, Boston.

Dr. George W. Crile, Cleveland: "Surgical treatment of exophthalmic goiter." Discussion, Dr. J. Chalmers DaCosta, Philadelphia; Dr. Dean Lewis, Chicago; Dr. Charles H. Mayo, Rochester, Minn.

Dr. Otto P. Geier, Cincinnati: "The physician and surgeon in the industrial era." Discussion, Dr. John J. Moorhead, New York; Dr. William O'Neill Sherman, Pittsburgh; Dr. Jonathan M. Wainwright, Scranton; R. M. Little, Safety Institute of America, New York.

THURSDAY

Dr. John B. Deaver, Philadelphia: "The acute abdomen." Discussion, Dr. J. M. T. Finney, Baltimore; Dr. George E. Armstrong, Montreal.

Major Gillies, R.A.M.C., Sidcup, Eng.: "Plastic operations for facial burns."

Dr. C. Jeff Miller, New Orleans: "Radiotherapeutic and other methods for treatment of cancer of the uterus." Discussion, Dr. James F. Percy, Galesburg, Ill, "Cautery"; Dr. Henry K. Pancoast, Philadelphia, "X-ray"; Dr. Harold C. Bailey, New York, "Radium."

FRIDAY

Convocation of the American College of Surgeons.

Conferring of honorary fellowships.

Presentation of candidates for fellowship.

Presidential address, Dr. William J. Mayo, Rochester, Minn.

Fellowship address, Sir Arthur Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences, as already announced, will hold its autumn meeting at Yale University, New Haven, on November 10, 11 and 12. Professor Henry A. Bumstead is chairman of the local committee, the other members being Professor Lafayette B. Mendel and Professor Ross J. Harrison.

IN accordance with the vote taken at the Baltimore meeting, the American Association for the Advancement of Science and the national scientific societies affiliated with it will hold their annual meeting at St. Louis, beginning on Monday, December 29. Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, will preside and the address of the retiring president will be given by Professor John M. Coulter, of the University of Chicago.

THE next general meeting of the American Chemical Society will be held at St. Louis, Mo., with the St. Louis Section of the American Chemical Society, from April 13 to 16, inclusive.

THE thirty-fifth annual meeting of the Indian Academy of Science will be held on Friday and Saturday, December 5 and 6, at Indianapolis.

DR. FRANK SCHLESINGER, of the Allegheny Observatory, was elected president of the American Astronomical Society at the recent Ann Arbor meeting. Dr. Schlesinger succeeds the late Edward C. Pichering, who for many years in succession had been elected to this office.

MAJOR GENERAL W. C. GORGAS has been elected an honorary member of the National Academy of Medicine of Peru.

PROESSOR ANTON J. CARLSON, chairman of the department of physiology at the University of Chicago, who was commissioned captain in the Sanitary Corps in 1917, made major in 1918, and lieutenant colonel in 1919, has returned to his regular work at the university. In the spring of 1919 Dr. Carlson was called to Paris and made the director of the division of the American Relief Administration known as the Children's Relief Bureau. He has since visted Poland, Czecho-Slovakia, Austria, Jugo-Slavia, Finland, the Baltic states and parts of western Russia, paying particular attention to putting the child-welfare work on a national and permanent basis.

HERBERT E. GREGORY, who for the past five months has been serving as acting director of the Bishop Museum in Honolulu, has returned to take up his work at Yale University.

It is announced that Dr. J. Rodríguez Carracido, the chemist and president of the University of Madrid, is a member of a Spanish delegation leaving soon for the United States.

Captain Caffe, formerly of the Royal Air Force, left Winnipeg, Manhattan, in an airplane on October 31, to attempt the rescue of J. B. Tirrell, the geologist and mining engineer, reported to be "frozen in" and without supplies in the Rice Lake district. Attempts made to reach Mr. Tirrell by boats have been unsuccessful.

Sir Bertram Windle, F.R.S., in his annual report to the governing body of University College, Cork, announces that his resignation of the presidency of the college will shortly take effect. He has accepted an invitation from St. Michael's College in the University of Toronto to deliver a course of lectures on "Science in relation to the scholastic philosophy" during the first three months of next year.

Dr. R. H. A. Plimmer, reader in physiological chemistry, University College, London, has been appointed head of the biochemical department of Craibstone Animal Nutrition Research Institute, which is under the direction of Aberdeen University and the North of Scotland College of Agriculture.

Dr. Donald W. Davis, Ph.D., has returned to his position as professor of biology at William and Mary College, Williamsburg, Va. He spent the last three months of his stay overseas in research work in genetics at the John Innes Horticultural Institution.

Professor Georges E. Dreyer, of Oxford University, delivered the first lecture at Western Reserve University School of Medicine on the H. M. Hanna Lecture Fund, on October 27, the subject being "Vital capacity and physical fitness."

UNIVERSITY AND EDUCATIONAL NEWS

It is planned to establish a post-graduate school in medicine in Western Reserve University, Cleveland, Ohio. The department is intended to offer opportunities for further study of practising physicians who desire to acquaint themselves with current medical and surgical investigation. The course will begin next June, and is being arranged by a committee of three members of the faculty of the school of medicine. There will be short, intensive courses, without degrees, and a longer course, which will lead to the degree of A.M. in medicine. The latter is especially designed for regular students who may wish to continue their study before taking up their practise. It will be in connection with the establishment of several teaching fellowships.

Lloyd's Register of Shipping has presented £10,000 to the fund which is being raised to establish a Degree in Commerce at the University of London.

In the Towne Scientific School of the University of Pennsylvania, Dr. Milo S. Ketchum, has been made professor of civil engineering, he filling the post made vacant by the death of the late Dr. Edgar Marburg. He brings with him as assistant professor Dr. Clarence L. Eckel, from the University of Colorado. This department loses Dr. William Easby, Jr., professor of municipal engineering and Charles L. Warwick, assistant professor of structural engineering.

Dr. A. G. Hogan has left Kansas State Agricultural College to take the chair of biochemistry in the medical school of the University of Alabama, at Mobile. He will be succeeded at the Kansas college by Dr. J. S. Hughes.

Paul Emerson, Ph. D. (Iowa State), has resigned as associate bacteriologist at the Idaho Agricultural Experiment Station to accept the position of assistant professor of soils and assistant chief in soil bacteriology at Iowa State College. In that institute H. W. Johnson, M.S., has been transferred from his position of assistant in soil bacteriology to that of associate professor of soils and assistant chief in soil chemistry in humus investigations.

Since Fordham Medical School closed the registration in the freshmen and sophomore classes and decided to close in 1921, Dr. Carl

P. Sherwin has been transferred from the medical school, where he held a professorship in physiological chemistry, to the university. The department of chemistry in the university has been entirely reorganized with Dr. Sherwin as the head; John A. Daly and George J. Shiple are are professors and Walter A. Hynes, William Wolfe and William J. Fordrung, assistant professors.

DR. H. L. IBSEN, of the University of Wisconsin, has been appointed assistant professor of animal husbandry in charge of the courses and the experimental work in genetics at the Kansas State Agricultural College.

CHARLES HARLAN ABBOTT, Ph.D. (Brown, '18), has become instructor in zoology in Massachusetts Agricultural College.

MR. HUBERT SHEPPARD has been elected instructor in anatomy in the University of Kansas.

DR. A. E. HENNINGS, formerly professor of physics at the University of Saskatchewan, Saskatoon, Canada, and more recently assistant professor of physics at the University of Chicago, has accepted an appointment in the department of physics at the University of British Columbia, Vancouver, Canada. The departmental staff as now constituted is represented by Drs. T. C. Hebb, A. E. Hennings, J. G. Davidson and Mr. P. H. Elliott.

DISCUSSION AND CORRESPONDENCE

NATURAL FIELD SANITATION IN CHINA

IN the thickly populated parts of South China there are a considerable number of people who financially are very poor; it is a constant struggle with them to obtain food for themselves and for any live stock which they may possess, such as chickens and ducks, a few hogs, or possibly a carabao. Fuel is also very scarce and such waste vegetable matter as becomes dried is promptly utilized for heating purposes. This struggle for food and fuel leads to a prompt utilization of all waste vegetable material. Small leaves, insignificant to us for this use, are picked up sometimes one by one and it is a very common sight to see small boys and girls, too small as yet to do heavy labor, picking up or sweeping up fallen leaves for fuel. Gardens and fields therefore are usually entirely free of old decaying vegetable material.[1] In this connection an observation upon the absence of leaf spot diseases on field crops in South China is of possible interest.

Sweet potatoes (*Ipomœa batatas*), tobacco (*Nicotiana tabacum*), *turnips* (*Brassica campestris*), *onions* (*Allium cepa*), *chard* (*Beta cicla*), beans (*Phaseolus* sp.), carrots (*Daucus carota*) and cauliflower (*Brassica* sp.) are commonly grown in South China. Observation of these field crops has shown them to be surprisingly free from the leaf spot diseases which would ordinarily affect these crops in the United States. These observations have been at two separate periods, at both times the weather being very moist and with temperatures which would not limit development of the causal fungi. It would seem as if these farmers in their utilization of all waste material as fuel and the consequent removal of sources of infection, maintain their crops almost entirely free from these diseases. That is, apparently the absence of leaf spot diseases may be accounted for by the field sanitation, practised unknowingly by the Chinese farmers.

These observations are put forward only as an illustration of what may be called field sanitation, carried out on a large scale with apparently successful results. This would suggest that in the United States much could be gained by more careful field methods and the

[1] Professor F. H. King in his very interesting book, "Farmers of Forty Centuries," discusses the use of compost heaps very completely. The use of compost heaps containing remnants and wastes of plant material is of course a great means for the dissemination of diseases of crop plants. Since one reading Professor King's work might consider it to refute the present suggestion, it seems well to explain that in South China such compost heaps are much more uncommon than in the region around Shanghai and Shantung province, and although compost heaps have been seen near Canton they are few and do not seem to play the part in the agricultural scheme that they do farther north.

elimination of sources of infection of crop plants.

The writer appreciates the danger of generalizing upon such a subject. However the two conditions, the one a prompt utilization of all vegetable material and the other an almost entire absence of leaf spot diseases, are both so noticeable that the coincidence and suggested explanation seem worthy of note.

Atherton Lee

Bureau of Plant Industry

A METHOD OF IMBEDDING IN PARAFFINE

The following method of imbedding tissues in paraffine preparatory to sectioning has proven so satisfactory in routine work in our laboratory that this brief note of description is offered.

The imbedding is done in paraffine buttons formed on the surface of cold water. Melted paraffine is allowed to flow from a pipette down the side of a glass dish with sloping wall, such as a finger bowl, nearly full of water. On reaching the surface, the paraffine hardens below, forming a button still liquid above and anchored securely at one edge to the glass. The tissue is now p'aced in the fluid paraffine and oriented. More paraffine may then be added to thicken the button if necessary. A label is attached by its end with a small drop of paraffine. The button is then disengaged from the class by a dissecting needle and carried on the point of the latter below the surface. It is at once transformed to a glass of water inverted over a basin, where it remains until solid.

Large thick buttons may be obtained in this way without the use of glycerin, paper boats or frames. The rapidity with which imbedding may be done by this method is perhaps its chief recommendation.

Leo H. Schatz

Reed College

QUOTATIONS

SCIENTIFIC AND INDUSTRIAL RESEARCH IN ENGLAND

The fourth annual report of the Committee of the Privy Council for Scientific and Industrial Research has just been issued; it covers the period from August 1, 1918, to July 31, 1919. Earl Curzon, of Kedleston, the Lord President, records that during the past year the work of the Department of Scientific and Industrial Research has steadily grown in usefulness and in amount. The passage from war to peace, he says, reveals more and more clearly as it proceeds the need for the sympathetic encouragement and organization of research in every sphere of national life. Encouraging progress is recorded in several directions. Thus a marked change is observed to be taking place in the attitude of industry towards scientific research; both masters and men are beginning to recognize its vital importance. Something also has been done to increase the number of trained research workers, the demand for whose services rose rapidly not only in industries, but also in the universities and government departments. The report of the Advisory Council, signed by the administrative chairman, Sir William McCormick, describes in greater detail the various branches of the department's work. The work of the Food Investigation Board grew enormously during the year. The field to be covered is so large and the range of scientific knowledge so wide, that only a complex organization could hope to deal with the problems effectively. The board accordingly set up six committees to deal respectively with fish preservation, engineering, meat preservation, fruit and vegetables, oils and fats, and canned foods; and these committees have in turn appointed seven special committees. The therapeutic uses of oxygen, shown by recent practise to be capable of very great extension, and being actively investigated by the Medical Research Committee in close cooperation with the Oxygen Research Committee of the Department. The Industrial Fatigue Research Board was established jointly by the Medical Research Committee and the Department, the former being responsible for administration. The demands made upon the Board have far exceeded all anticipation, while industrial un-

rest, believed by many to be closely related to present ignorance of the laws of fatigue and the best modes of applying them in practise, has emphasized the importance of this branch of research.—*British Medical Journal.*

SCIENTIFIC BOOKS

Constructional Data for Small Telescope Objectives. Calculated at the National Physical Laboratory. By T. Smith and R. W. Cheshire. 4to. Pp. 32. *Additional data for the construction of small telescopes objectives.* By the same authors. Prepared at the request of the Director General of Munitions Supplies. 4to. Pp. 82. London, Harrison and Sons, 1915 and 1916. Price, 2s. 6d. and 5s.

During the war every possible stimulus and aid was offered to manufacturers by the English government no less liberally than by our own, and of course some years earlier. The present volume is intended to save the manufacturer of small telescopes a large part of the time and expense that would be consumed in perfecting his models. British glass factories, aroused to the emergency, had succeeded in producing new varieties and a large quantity of optical glass, duplicating in feverish haste inventions evolved at leisure by German scientists and artisans during the previous thirty years. But the grinding of lenses and their combination into effective sets for binoculars, gun-sights, range-finders and photographic cameras can not be begun until protracted mathematical calculations are finished. Years of preliminary study have often gone into the making of an improved objective. One must conjecture, design, calculate and compare. Obviously, carefully systematized records of previous studies would save labor: cooperation is economy. These tables mark a new application of this principle. Glass factories supply, with a list of available melts, their indices of refraction and dispersion. By the tables one can decide quickly upon the comparative merits of doublets made from those materials.

Objectives are usually made of from two to six separate lenses. Each component by itself gives a defective image. Rings of blue or red encircle each bright object, and in place of points of light there appear hazy circles or fantastic comet-like shapes. If at the center of the field a picture is fairly good, the parts toward the edge are distorted. To improve such crude images, at least two lenses must be used in combination. Accordingly data are here given for suitably matched two-lens objectives, one lens of crown glass, the other of flint glass, so proportioned as to eliminate at least two of the so-called aberrations, or defects of the image. The figures relate to six kinds of crown glass (a seventh in the supplement) and six kinds of flint glass. The selection of typical sorts is not made at random, nor at equal intervals in the whole range of possibilities, but near what we may call, borrowing a statistical term, "accumulation" points of the catalogue list. To suit each of six sets of conditions the proper dimensions are found for every combination of one kind of crown with one kind of flint, so that every table contains 36 entries.

The first set of tables (A) eliminates color and spherical aberration; not, of course, for all kinds of light and for objects at all possible distances, but for two different wave lengths of light and for objects at a distance so great that the rays striking the glass are practically parallel ("object at infinity"). To the removal of color from the image corresponds an algebraic equation of the first degree between the focal lengths of the two lenses, both considered as "thin"; while that for spherical aberration is of the third degree in the curvatures, or reciprocals of the radii of the spherical surfaces of the lenses. But when the two lenses are to be in contact, and their contiguous surfaces are exactly alike so that they may be cemented, the third degree equation for that common radius is reduced by one degree, to a quadratic. For this equation then there are two solutions, and so two tables of curvatures. Indeed all the pairs here tabulated are cemented lenses. Since two of the four spherical surfaces have equal radii for any desired focal length, there re-

main only two unknowns to be determined by conditions which will eliminate aberrations. For the first, our authors select color —chromatic aberration. The second condition in one case that for spherical aberration; in another, for coma; and in a third case, for equality of three radii instead of merely two. Evidently therefore this publication, though valuable as a first, is only the first among a large number of desirable thesauri for optical designers.

Of two solutions for the same physical condition, equally correct mathematically, one may prove in practise far superior. Tables *A* and *B* enable us to compare these two, both free from spherical aberration. thirty-six samples of each. To the cautious tyro, and also, it appears, to the expert, it seems better to select surfaces of small curvature where possible; although in microscopes, as Abbe demonstrated, such counsel is often misleading. Taking as unit the focal length of the combined lenses, Table *A* shows radii of curvature varying from 0.2977 to 5,000 or, for the cemented surface alone, from 0.2977 to 0.4671. The second solution, or Table *B*, shows radii for this middle surface of from 0.1705 to 0.3495. On this account therefore Table *A* gives the more useful patterns. An additional table gives for each type the amount of coma left uncorrected, which averages nearly the same for *A* as for *B*.

Both *A* and *B* are calculated for the arrangement of crown lens preceding, flint following. The reversed arrangement is provided for in Tables *E* and *F*, and these call for radii which are individually and on the average considerably smaller, curvature therefore greater; but in *E*, the coma remaining in the system is somewhat reduced. Other tables are for forms where three radii are equal and the fourth surface nearly flat, so that the cost of grinding might be lessened even though the telescope would be less efficient. These last are accompanied by an exhibit of the residual amount of both spherical aberration and coma. Two further tables promise freedom from coma, with stated amounts of uncorrected spherical aberration.

So far, it has been assumed that the thickness of the lenses is so small as to be negligible. Of course the diameter that is needed for a particular purpose may cause a thickness which is far from negligible, especially in types having one or more fairly large curvatures. To allow for this, the authors fix arbitrarily a "standard thickness" of one-fortieth the focal length for a convex lens, one eightieth for a concave, and furnish for these standards thicknesses tables of two sorts. The first shows how much the focal length is diminished by standard thickness when one uses the radii taken from a thin-lens table, and the second shows by what amount the curvature of the fourth surface (the most nearly flat) may be modified to restore the focal length to its intended value, unity.

Such an alteration of one surface is however only a make-shift, as is seen from the later tables (1916), "Additional data," etc. To alter the curvature of a single one of the four surfaces disturbs not only the focal length, but also the precise balance of both the aberrations which are already eliminated. The authors recommend it indeed only when the focal length is to be short. Otherwise it is necessary to change slightly all three curvatures from the 1915 tables. Very full information is given as to the amount of change. First they give factors for interpolation when either index differs slightly from that for which the earlier tables were computed. Then back to this table are referred, in the next following series, the effects of standard thickness upon chromatism. Namely, the corresponding change to be made in the ratios of indices for flint and crown is stated, so that by two tables the changes of curvatures can be found. Next comes the effect upon spherical aberration resulting from standard thickness, and last, the necessary changes in curvatures to correct that error. But it is recommended that when two kinds of aberration simultaneously become serious in amount, the curvatures be computed entirely *de novo*, since the errors are not wholly independent. Such computation is of course greatly facilitated by knowl-

edge of any approximate values for the radii; and this constitutes one of the chief reasons for expecting these tables to prove generally serviceable.

The authors deserve the thanks of optical computers further, in particular, for their care in testing results by trigonometrical calculations. Judging from more than a hundred such verifications, they inform us, the small errors in the approximate values of spherical aberration occur only in the fourth decimal place, so that they would hardly influence the specifications to be given to the mechanician. The data in the first tables run to three decimal places.

Of major significance are the graphs, pages 80 and 81, showing the performance of typical lenses of the various types at different apertures. Group *A* makes quite the best showing. The final page, with some general conclusions, may well be read first.

American readers will have noticed already, from certain reports published by the Bureau of Standards, that projects not wholly dissimilar to this have been under consideration, and are already partially realized, for lightening the arduous labor of finding satisfactory first approximations in definite types of lens design.

HENRY S. WHITE

BUREAU OF STANDARDS

SPECIAL ARTICLES

ELECTROLYTES AND COLLOIDS

THE effect of ions on the physical properties of proteins is one of the most interesting chapters of colloid chemistry. The work on this topic quoted in the textbooks of colloid chemistry suffers from two sources of error, namely, first, that the effect of the hydrogen ion concentration is generally ignored, and second, that the effect of the nature of ions on the physical properties of proteins is often ascertained in the presence of an excess of an electrolyte. Proteins are amphoteric electrolytes and therefore occur in three states according to the hydrogen ion concentration, namely as: (1) protein, free from ionogenic impurities, (isoelectric protein); (2) metal proteinates, *e. g.*, sodium proteinate or calcium proteinate, etc.; and (3) protein acids, *e. g.*, protein chloride or protein sulfate, etc. For gelatin the hydrogen ion concentration defining the isoelectric point is, as Michaelis[1] first showed, about 2×10^{-5} N (or in Sörensen's logarithmic symbol pH $= 4.7$). At this hydrogen ion concentration gelatin can practically combine with neither anions nor cations of an electrolyte. When the hydrogen ion concentration becomes lower than 2×10^{-5}, *e. g.*, through the addition of NaOH, part of the isoelectric gelatin is transformed into sodium gelatinate, and the relative amount of isoelectric or non-ionogenic gelatin transformed into sodium gelatinate increases with the diminution of the hydrogen ion concentration. Sodium gelatinate can exchange its cation with the cation of neutral salts but is not (or practically not) affected by the anion of a neutral salt. When we raise the hydrogen ion concentration of gelatin solutions above that of the isoelectric point, *e. g.*, by adding HCl, isoelectric gelatin will be transformed into gelatin chloride and the transformation will become the more complete the higher the hydrogen ion concentration, until finally all the isoelectric gelatin is transformed into gelatin chloride. The gelatin-acid salts can exchange their anion with the anion of other salts but are not (or practically not) affected by the cation of other salts.[2]

While isoelectric gelatin has a minimal osmotic pressure, a minimal power of swelling, a minimal viscosity, a minimal transparency, a minimal alcohol number, etc., gelatin salts, *e. g.*, sodium gelatinate or gelatin chloride, have a high osmotic pressure, a high power of swelling, a high viscosity, etc. The writer has been able to show by volumetric analysis that the osmotic pressure, the power of swelling, etc., of gelatin increase with the relative amount of isoelectric gelatin transformed into gelatin salt.[3] The physical properties of gelatin, *e. g.*, its

[1] Michaelis, L., "Die Wasserstoffionenkonzentration," Berlin, 1914.

[2] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 39, 237.

[3] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 237, 363, 483, 559.

osmotic pressure, depend therefore not only upon the concentration of the gelatin in solution but also upon the hydrogen ion concentration.

Colloid chemists usually state only the amount of acid added to a protein without measuring the hydrogen ion concentration of their protein solution. The effect of the addition of the same amount of acid upon the chemical and physical properties of gelatin is entirely different according to the hydrogen ion concentration of the gelatin used. When a slight amount of acid is added to isoelectric gelatin it will increase its osmotic pressure while the same amount of acid if added to gelatin with a $pH = 3.3$ or to neutral gelatin ($pH = 7.0$) will diminish its osmotic pressure. Since the hydrogen ion concentration of commercial gelatin varies and since, moreover, the combining power of different acids with gelatin varies also,[4] the results obtained by the addition of electrolytes without measurement of the hydrogen ion concentration are irregular and confusing.

In addition, the properties of gelatin salts depend upon at least two more variables, namely, the nature of the ion in combination with the gelatin and the concentration of electrolyte present. When we transform 1 per cent. solutions of isoelectric gelatin into sodium gelatinate and calcium gelatinate both possessing the same hydrogen ion concentration (*e. g.*, 10^{-9}) the sodium gelatinate has an osmotic pressure more than twice as great as the calcium gelatinate. This difference is not due to a difference in the degree of electrolytic dissociation since both solutions have the same conductivity.[5] When we add increasing quantities of neutral salts or alkalies to the two solutions the osmotic pressure is depressed in both solutions and if enough is added the osmotic pressure falls to almost zero in both solutions. (If we add acid, the same will occur but for another reason, the metal gelatinate being brought to the isoelectric point, and, by addition of more acid, being transformed into gelatin-acid salts.)

The same difference as between sodium and calcium gelatinate exists between gelatin chloride and gelatin sulfate[4] and this difference is also obliterated when neutral salt or acid is added to the solution. (The addition of an excess of alkali would transform the gelatin acid into isoelectric gelatin and finally into metal gelatinate.)

If we wish to investigate the specific effect of different ions on the physical properties of gelatin (or of proteins in general) it is therefore necessary to avoid an excess of electrolytes. The writer proceeds in the following way. Finely granulated (commercial) gelatin is brought to the isoelectric point by the method described in the writer's previous publications. Isoelectric gelatin if properly washed will lose its ionogenic impurities. Just enough acid or alkali is then added to 1 gm. of isoelectric gelatin to produce a gelatin salt (either gelatin acid or metal gelatinate) of the desired hydrogen ion concentration. Since there exists an equilibrium between free acid (or free alkali) gelatin salt and isoelectric (non-ionogenic) gelatin two solutions of metal gelatinate (*e. g.*, Na gelatinate and Ca gelatinate) each containing 1 gm. of isoelectric gelatin and each possessing the same hydrogen ion concentration contain the same proportion of metal gelatinate and non-ionogenic gelatin. Differences in the physical properties of these two solutions may be ascribed to differences in the effect of the metal ion in combination with the gelatin. The same is true for solutions of gelatin chloride and gelatin sulfate of the same hydrogen ion concentration if prepared from isoelectric gelatin of the same concentration. If this procedure is not followed, erroneous results will be obtained such as are found in the textbooks of colloid chemistry. Thus it is generally stated that acids and alkalies increase the osmotic pressure of gelatin while neutral salts depress it. This statement is entirely wrong and due to the fact that the experimenter responsible for this statement did not work with gelatin

[4] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 559.

[5] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 483.

solutions standardized according to the method just described. Correct and constant results can only be obtained if such a method of standardization is used.

Another error which permeates the literature of colloid chemistry is due to Hofmeister's experiments on the influence of different ions on the swelling of gelatin. Hofmeister's experiments were all made in the presence of an excess of electrolyte, in which the specific effect of different ions can no longer be recognized. When we prepare sodium and calcium gelatinates or gelatin chloride and gelatin sulfate according to the writer's method and put them into distilled water we find that the sodium gelatinate swells considerably more than the calcium gelatinate and that the gelatin chloride swells considerably more than the gelatin sulfate of the same concentration of isoelectric gelatin and of hydrogen ions. If, however, we add neutral salt or alkali to the two solutions of metal gelatinates or neutral salts or acid to the solutions of gelatin chloride and gelatin sulfate the differences in swelling disappear since in all cases the swelling is repressed. It is only necessary to add enough electrolyte so as to make the solution M/4 or even less to completely mask the differences. The writer feels therefore justified in stating that if we wish to compare the effect of different ions on the physical properties of gelatin we must avoid the error of adding an excess of electrolyte to the solution.

A writer[6] in *Nature* has raised the objection that Sörensen's experiments on the osmotic pressure of egg albumin were done in the presence of ammonium sulfate, but he overlooks the fact that Sörensen's experiments[7] were not concerned with the comparison of the effect of different ions on the osmotic properties of egg albumin. If it had been Sörensen's intention to compare the osmotic pressure of albumin chloride with that of albumin sulfate or of sodium albuminate with that of calcium albuminate he would have found it necessary to take cognizance of the fact that the specific effects of different ions on the physical properties of gelatin (or possibly of proteins in general) are repressed in the presence of an excess of electrolyte. As far as the writer is aware there is no disagreement between his results and views and those of Sörensen, though there is a difference in the method employed and the nature of the protein used.

The writer's recent experiments seem to indicate that the specific influence of the nature of ions as well as the depressing effect of an excess of electrolyte on the physical properties of colloids are connected with the electrification of water, and that this connection seems to be the same in the case of crystalloidal and of colloidal solutions of electrolytes. Since it would exceed the limits of this note to discuss these observations, the reader interested in this feature of the problem is referred to the writer's publications on the subject in the current numbers of the *Journal of General Physiology* and the *Proceedings of the National Academy of Sciences*.[8]

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NEW YORK

[6] *Nature*, 1919, CIV. (September 4), 15.

[7] Sörensen, S. P. L., *Compt. rend. trav. Lab. Carlsberg*, 1917, XII.

[8] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 717; 1919–20, II., 87.

THE AMERICAN CHEMICAL SOCIETY. II

DIVISION OF PHARMACEUTICAL CHEMISTRY

F. O. Taylor, *Chairman*

George D. Beal, *Secretary*

A new field of phytochemical research opened up by the cultivation of medicinal plants on a semi-economical scale: EDW. KREMERS.

Some of the characteristic toxic principles of western poisonous plants: O. A. BEATH.

A comparison of several methods for estimating quinine and strychnine when occurring in the same solution: A. R. BLISS, JR.

Quantitative determination of mercury: SIGMUND WALDBOTT. Precipitate the mercury from dilute solution completely on copper foil, dry and weigh the latter, then expel the mercury by holding the foil *above* a flame until the gray film has

just disappeared, then weigh the foil again. The difference in weight is due to the volatilized mercury. In one instance, 99.83 per cent. of Hg was recovered from HNO_3 solution.

The U. S. P. assay of Donovan's solution: Sigmund Waldbott. The U. S. P. assay of a certain well-prepared Donovan solution gave far too low results in mercuric iodide contents. Preliminary experiments indicated that the two-fold step in the U. S. P. determination of mercury involved some loss. A simple method for the determination of mercury in Donovan's solution is proposed, as follows: Precipitate 25 c.c. of Donovan's solution with excess of freshly prepared ammonium sulphide solution, decant and filter through a double filter, wash, dry at 100° C. and weigh, the two filter papers being previously counterpoised. Two determinations gave satisfactory results.

The theory of emulsion making: W. D. Bancroft.

DIVISION OF WATER SEWAGE AND SANITATION

Robert Spurr Weston, *Chairman*

W. W. Skinner, *Secretary*

Determination of iodid and bromid in mineral waters and brines: W. F. Baughman and W. W. Skinner.

The determination of bromid and iodid in mineral waters and brines: H. H. Willard and C. C. Meloche. The iodid is oxidized to iodate by adding to the neutral solution of salts a considerable excess of permanganate and boiling for a moment. The solution is cooled, a small amount of hydrochloric acid is added, more than enough to liberate all the bromin and a current of air passed through the hot solution to remove all bromin which is collected in sodium hydroxide, reduced to bromid, precipitated as mixed silver chlorid and bromid, fused, weighed, fused in chlorin and weighed again. From the loss in weight the amount of bromin is calculated. The residue in the retort is treated with alcohol to reduce the excess of permanganate, and the manganese dioxide filtered off. To the filtrate potassium iodid is added then excess of acid, and the iodine liberated is titrated with thiosulfate.

The removal of colloidal silicic acid and clay from natural waters: Otto M. Smith.

A study of well water in a rural community: G. O. Higley. This study was begun because of the fact that the death rate from typhoid in Delaware County was 25.2 per 100,000 of population, as against 6.9 for Cuyahoga County (Cleveland) and 3.9 for Hamilton County (Cincinnati). The writer with assistants personally visited about 675 homes, noted the condition of the well and surroundings, talked with the people, emphasizing especially the danger if human excreta finds entrance into well water, and took a sample of water in a sterilized bottle for analysis. The tests made were the lactose broth and the chlorid tests. About 40 per cent. of the water from dug wells was found polluted. As the eastern half of the county is underlain with shale, and the western half with limestone it was thought that the degree of pollution of well water might be found markedly different in the two sections; however the work is still too incomplete to warrant any report on this point.

Field methods for the chlorination of small amounts of water: F. R. Georgia. This paper describes conditions of water supply prevailing in the area occupied by the First Depot Division in France. Various methods and devices are described and illustrated for the continuous chlorination of small supplies of water. Some of these devices were constructed in the field from materials at hand. The Lyster bag for water sterilization is described and methods for its use and control are discussed. Tabulations of the bacteriological results obtained are given.

The electrostatic precipitation of dust as applied to the sanitary analysis of air: J. Penteado Bill. An apparatus was devised for producing a rectified alternating current of about 20,000 volts. The collector is a 12-inch piece of aluminum tubing, 2½ inches in diameter, through which air is drawn by a motor at the rate of 273 cubic feet per hour. Seventy-one tests, each of one hour's duration, were made with this apparatus and a Palmer water spray sampler in the various buildings and departments of a large plant making rubber goods. The following determinations were made for each test: Relative and absolute humidity, barometric pressure, weight of total sediment in 50 c.c. sample of 100 c.c. aqueous suspension of particles collected in both machines, weight of organic and inorganic fractions of each 50 c.c. sample, the weight of the aluminum collector before testing, with its accumulated dust charge, and with the dust portion still retained after rinsing out to make up a 100 c.c. aqueous suspension. Counts were made on each suspension. The high tension weight figures were reduced to figures comparable with the rate of air passage through the Palmer machine. The resulting figures when compared with the weight figures of the Palmer determinations, together with a comparison of the

counts made on both Palmer and high tension suspensions, showed, on a percentum basis, that the Palmer apparatus collected 59.9 per cent. of total particles counted in the high tension suspensions, 63.3 per cent. of the total sediment, 66.6 per cent. organic portion, and 55.2 per cent. inorganic portion collected by the electrical machine. Based on total sediments collected per 240 cubic feet of air in each process whose air was sampled, the Palmer collected 63 per cent. of the amount retained by the electrical method. The conclusions are that the Palmer apparatus under similar conditions is 61.6 per cent. as efficient as the electrical method (average of above figures). The electrical apparatus used is too bulky for ordinary field work, and suggestions are made for its simplification. It is felt that the findings warrant further study of the electrical precipitation method as applied to the sanitary analysis of air.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

W. E. Henderson, *Chairman*

W. A. Patrick, *Secretary*

The vapor pressures of mercury in the range 120° to 250°: ALAN W. C. MENZIES. Two McLeod gauges containing dry hydrogen over pure mercury were connected with the same pressure reservoir. One of the gauges was raised to the desired temperature and both gauges then operated simultaneously. The vapor pressure of mercury was calculated from the difference, due to mercury vapor, of the pressure readings given by the hot and the cold gauges respectively.

The vapor pressure of tetranitromethane: ALLAN W. C. MENZIES. These measurements covered the range 40° to 126°, thus including the solution of War Problem No. 142 of the National Research Council. The entropy of vaporization of this liquid appears to be normal.

Production of hydrochloric acid from chlorine and water: H. D. GIBBS.

Opening up minerals with phosgene: CHARLES BASKERVILLE. The bleaching of ferruginous silicous bricks by the action of phosgene in plants where that poisonous gas was manufactured has been noted. The useful application of this method of conversion of iron oxides into volatile ferric chloride, with a bleaching, for glass-sand, was suggested by Hulett. Phosgene under the influence of heat is very reactive at temperatures of 450° C. and above. We have converted oxides of aluminum and cerium, insoluble in acids, oxides of zirconium and thorium, insoluble in acids except boiling concentrated sulphuric acid, directly into water soluble chlorides or oxy-chlorides. Bauxite and carborundum yield ferric and aluminum chlorides. Zirconium chloride has been distilled from zircon (silicate), ferric chloride from the contaminating iron being fractioned away due to its greater volatility. The silica remains behind. Thorianite yields soluble thorium and uranium chlorides. The procedure is very simple. The pulverized material is heated in a quartz tube in a stream of gaseous phosgene. It is proposed to extend the work to a large number of the rare-earth minerals.

The preparation of colloidal gold and silver by new reducing agents: HARRY N. HOLMES.

Phase rule studies of the nitrotoluenes: C. H. HERTY, JR.

Compression by adsorption: WILLIAM D. HARKINS and D. T. EWING.

The work done by the attraction between a mercury surface and the surface of an organic substance: W. D. HARKINS, E. H. GRAFTON and D. T. EWING.

The change of molecular kinetic into molecular potential energy: WILLIAM D. HARKINS and L. E. ROBERTS.

The separation of yttrium from the erbium earths: P. H. M. P. BRINTON and C. JAMES.

A new method for the determination of zirconium: M. M. SMITH and C. JAMES.

The effect of lead upon thorium nitrate in aqueous solution: FANNY R. M. HITCHCOCK.

An electrometric study of the neutralization of monocalcium phosphate: GERALD WENDT, A. H. CLARKE and S. M. WEISMAN.

The existence of an ozone form of hydrogen: GERALD L. WENDT and ROB. S. LANDAUER.

Action of thiosulfate on arsenate in acid solution: GEO. SHANNON FORBES and O. J. WALKER. Thiosulphate in excess precipitates As_2S_5 from H_3AsO_4 in HCl (Vortmann, 1889). We combined reactants, varying one concentration at a time, and plotted S_2O_3/H_3AsO_4 against HCl/H_3AsO_4 for incipient precipitation. Given one concentration constant, any curve has a horizontal part along which $S_2O_3/H_3AsO_4 = k = 2$, meeting a nearly vertical part when $HCl/H_3AsO_4 = 2$. This indicates a complex, $H_3AsO_4(HS_2O_3)''_2$, but its average hydrogen content decreases with increasing $S_2O''_3$. Trithionate, with thiosulphate, accompanies As_2S_5 along the "vertical" lines.

$$2H_3AsO_4\cdot(HS_2O_3)_2'' + 6HS_2O_3' \\ = As_2S_5 + 5S_3O_6'' + 8H_2O.$$

Pentathionate, with sulphite, accompanies As_2S_3 along the horizontal lines.

$$4H^{\cdot} + 2S_2O_3'' + S_3O_6'' = S_5O_6'' + 2SO_2 + 2H_2O.$$

Specific heat determinations with an adiabatic calorimeter: Farrington Daniels and Charles B. Hurd.

The partition of metallic radicals between a salt phase and an alloy phase: Herbert F. Sill.

The retention of bromine by silicic acid gel: W. A. Patrick and E. L. Ryerson.

Determination of the viscosity of pyroxylin solutions: E. F. Higgins and E. C. Pitman.

A slide rule for special cases: F. C. Blake.

Adsorption by precipitates. (II.), the adsorption of anions by hydrous ferric oxide: Harry B. Weiser and Edmund B. Middleton.

The physical character of hydrous ferric oxide: Harry B. Weiser.

Flame reactions of selenium and tellurium: Harry B. Weiser and Allen Garrison.

The catalyst in the oxidation of ammonia: G. A. Perley.

Equilibria in the systems: carbon disulfide, methyl alcohol and carbon disulfide, ethyl alcohol: E. C. McKelvy and D. H. Simpson. The mutual solubility relations of the two pairs of liquids were determined over practically the whole range of concentrations paying particular attention to the purity of the materials used. The following values were obtained for the critical solution temperature and the critical concentration: for methyl alcohol—carbon disulfide + 35.7°, 84.7 per cent. CS_2; for ethyl alcohol—carbon disulfide — 24.4°, 82.7 per cent. CS_2; applications to the determination of small quantities of water in the alcohols and the analysis of anhydrous methyl and ethyl alcohol mixtures were pointed out.

Notes on the estimation of nitrates and nitrites in battery acids: Lily Bell Sefton.

A metal to glass joint and some of its applications: E. C. McKelvy and C. S. Taylor.

Fluorides of cobalt, nickel, manganese and copper: F. H. Edmister and H. C. Cooper. The fluorides of cobalt, nickel, manganese and copper can be prepared by dissolving the hydroxide or the carbonate of the metal in hydrofluoric acid, the same product being obtained, whichever is used. In all cases a crust-like product was obtained. By recrystallizing from water, slightly acidulated with hydrofluoric acid, crystals of the acid fluorides were formed and analyses and measurements of these crystals were made. The analyses indicated that these salts all form an isomorphous series but the crystallographic measurements showed that only the cobalt, nickel and manganese salts are isomorphous, while the copper salt belongs to a different system. The formulas of all four fluorides are of the same acid fluoride type: $MF_2.5HF.6H_2O$. It was surprising to obtain the acid fluoride by recrystallization from water, a basic salt being expected under these conditions. These acid fluorides are not permanent in the air but decompose, losing hydrogen fluoride and, in the case of copper, losing water also, so that the crystals used for analyses must be carefully selected. The formation of a hydrated, non-crystallized crust is distinct from that of the hydrated acid fluoride crystals. In this crust the ratio of metal to fluorine, for the cases of cobalt and nickel, was found to be about one to two, with varying water content. This crust differs from the crystals in solubility and form, as well as in composition. We have arrived at the conclusion that the crust described by Berzelius as containing two molecules of water, the crust later described by Clarke as containing three molecules of water, and the crust and powder obtained by us are the same, the water content being variable and the crystal form being undeveloped. All were obtained in the same manner.

The determination of mercury: H. B. Gordon.

The preparation and uses of $TiCl_3$ solution: F. L. English and H. S. Tanner.

Contrasting effects of sulfates and chlorides on the hydrogen ion concentration in acid solutions: A. W. Thomas and M. E. Baldwin.

Chromophor tautomerism in indicators: William C. Arsem.

Charles L. Parsons,
Secretary

(To be continued)

SCIENCE

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INDUSTRIAL RESEARCH IN SMALL ESTABLISHMENTS

IN the past few years, and particularly during the war, research in connection with industry has had much consideration. Most of our large technical societies have devoted sessions to its discussion and have listened to admirable papers on the subject. I hope not to retraverse the ground thus covered. In this audience the vital importance of research to our technical industries would not need arguing even if it had not been amply argued. In these discussions research has been considered as something to be carried on in large well-organized laboratories, and for that reason possible only for large companies, for associated companies managing a cooperative laboratory or for government laboratories and the like. I believe that this way of thinking of research unnecessarily restricts it, and that differently conceived its usefulness to small as well as large establishments would become evident and might result in its large extension.

The various activities covered by such titles as "Research, Development and Technical Control" are those which should be assumed by a research department in a small business. In order to avoid a cumbersome name for such a department, I want to make a plea for a definition of technical research which some of you may think degrading. Doubtless you are accustomed to thinking of research as an adventure into the realms of the absolutely unknown. A department capable of research in this sense will only be possible in a small business when that business happens to have in it a real scientist. But every technical business (and what manufacturing business is not technical?) is continually confronted with the need of more information than is possessed by its regular staff in regard to processes, characteristics of materials, etc., and if it is to develop realizes that it must find new fields for

its product and find new products to sell. The most advantageous solution of problems of this character can not be left to people who are busied with the routine problems of sales and production. They can best be handled by a staff, even if a very small one, set aside for this purpose. I want to suggest that any department having such functions may be called a research department, and that industrial research may be defined for any given establishment as all that class of work which enlarges the technical horizon of the establishment beyond what is necessary for the routine production and test of its product. You will note that this will make a sharp distinction between a research laboratory and a testing laboratory. I should not want to see a chemical laboratory, however large and elaborate its equipment or however highly trained its staff might be, called a research laboratory if its sole function happened to be routine analysis and check on the product. On the other hand, I should like to see any little room with even a very meager equipment and staff, perhaps only a single individual, called a research laboratory provided the functions of that individual and equipment were solely the improvement of processes, investigation of properties of materials new to the industry, development of new products, etc. And I should want to have it called a research department even if the research be chiefly carried on in libraries or other places for the purpose of bringing information, elsewhere well known, to an establishment to which that information happens to be new. This conception of research widely recognized might be the occasion for many small industries to start research departments, which these industries now regard as possible only for large capital. In this sense many small industries already have individuals with research functions who have other duties as well and do not clearly recognize their research functions. Under these circumstances both the research and the other work suffer, and as the business develops research does not find the best relation to the work as a whole.

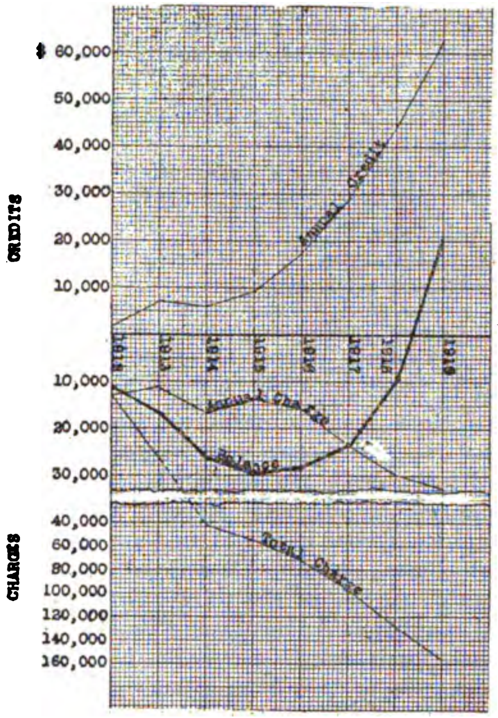
Research, development and technical control merge into each other at many points, and in all but very large establishments can probably best be carried on by a group working under one head. Why attempt lines of demarcation?

In order that research may find its fixed and recognized place in industry it is desirable that it be carefully planned and controlled, and that its results be carefully watched. So far as I know, these two conditions of the successful coordination of research with industry have not been discussed. Control in the sense of control of the research in the laboratory after it has been decided on has had discussion, and I do not refer to it but to the determination of the subjects which shall be investigated in the research department and the decision as to when the research is completed, or, in case it is one that does not lead to satisfactory results, when it shall be abandoned. For some five or six years this class of decisions in connection with our research department has been made by a committee of which the president of the company, the head of the research department, and representatives of the sales, engineering and production departments are members. This committee, called the research committee, meets once in two weeks, passes on all new subjects for the research department to handle, listens to reports on the progress of the work in hand and passes on recommendations in regard to the conclusion or discontinuance of work. In this way the work of the research department is well coordinated with the needs of the business as a whole. As a further factor in coordination the head of the research department is one of the board of directors and sits on the executive committee. The research committee has nothing to do with the internal administration of the department, which is left entirely to its own staff.

Records of the results of a research department can best be kept by the accounting department. It is just as important to know the cost of research as of any other department, and, as in other cases, the usefulness of the record depends to a very large extent on its subdivision. It is worth while to know what investigations contribute to business success and what ones do not.

Some years ago we worked out a plan of determining research cost and making credits to the department which has given us much valuable information. Each investigation undertaken has its cost record kept by the accounting department in the same way that a production order has. We of course do not ask our research men to register their time on a time clock or anything of that kind, but we do ask them to make a memorandum of the work on which they spend their time and turn in to the accounting department once a week a statement of the distribution of their time over the orders running in the department. Similarly, expenses and costs of materials are kept, and when an investigation is closed its total cost is determined. If it happens to be one that has to do with manufacturing processes, such as test of new materials, etc., or development of new methods, it is either charged to general expense or to the expense of some particular product. If, however, it is a piece of work which results in the development of a new instrument or product for sale, it is treated in the same way that a new instrument developed and brought in by an outsider would be. The research committee decides how much royalty can properly be charged to the cost of the instrument, and then as each instrument is made the royalty is added to its cost and is credited against its cost account in the research department. In that way a continuous record of the usefulness of the research to the business is available. In cases of minor importance it is customary to discontinue credits when the cost has been covered. In cases where new products result they are allowed to run on indefinitely. Successful developments accumulate royalties that more than pay for the cost of their research and offset the costs of work that leads to nothing. The diagram shows the relation of annual and accumulated costs of research to the annual and accumulated credits since the department was given a distinct place. In a little over six years the total credits had equalled the total charges and the balance went to the credit side. On the books the account is closed out each year to profit and loss. It is carried forward as a memorandum account only. In the earlier years of the record the total volume of business done by the company was but a few hundred thousand dollars per year.

To summarize, I am making a plea for a



conception and organization of research which will allow it to emerge as a distinct department in any growing technical business and take its proper place just as sales, production and accounting do. Any technical business ambitious to grow and render worthy service must in some way avail itself of research. Kenneth Mees and others have pointed out how industry in the past has developed around invention and research, although the distinctiveness of these functions was not clearly recognized, and in many cases they were not directly associated with the business which profited by them. Certainly an enterprise will have a more worthy and normal growth if its need for research is early and clearly recognized, and the research department will more easily find its proper relation to the business as a whole if it is established early and its place and functions are defined.

After a business has assumed large proportions, and research functions are distributed in scattered manufacturing and engineering departments, it is difficult to gather them together and coordinate them.

Let me remind those of you who may think this conception of research degrading that the present scientific limitation of the word is modern and confined to the exact sciences. The Century Dictionary gives its definitions in this order:

1. Diligent inquiry, examination or study,
2. Laborious or continued search after facts or principles,
3. Investigation,

and quotes from Cowper

> He sucks intelligence in every clime
> And spreads the honey of his deep research
> At his return—a rich repast for me,

so I think that the definition which I propose does not violate good usage. Even if it did would not the possibilities of development and usefulness to industry which this definition allows justify it in the same way that Bryce, in his "American Commonwealth," writing of the third quarter of the last century, said that the application of the name "university" to many institutions, which were no more than colleges or in some cases high schools, was a favorable sign because it showed an aspiration, and that where the aspiration existed the reality would follow? We all know to what a large extent this forecast has come true.

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Philadelphia, Pa.

THE NATURALIST'S PLACE IN HIS COMMUNITY[1]

Before beginning discussion I may say that I am not trying to say anything new or original and that I am not quite sure that I shall be able to make myself entirely clear in the limited time at my disposal. I do think, however, that the points which I shall mention should be more often opened to serious consideration.

Inasmuch as there are probably about as many different notions of "naturalist" as there are users of the word it may be necessary to say that by this term I now mean any one who is actively interested in living things as such.

In primitive societies most of the leaders are naturalists. In fact in most cases their leadership depends on attainments of that sort. The medicine man gains and holds his position very largely through his shifty use of knowledge of certain characteristics of animals in general and of his fellows in particular. The chieftain also usually bases his influence on successes derived from familiarity with activities of all sorts of animals. Certain women may gain indulgence or even general respect through exceptional familiarity with medicinal and food values of great numbers of plants and animals. It is, of course, easy to see that primitive leadership is thus conditioned because primitive man is individually in contact with the natural environment and appreciative of its mysteries; also because in an unspecialized social group all the members are sufficiently acquainted with every phase of activity to be able to understand and fairly to evaluate unusual skill and intelligence.

As society advances in complexity from the primitive stage and as more and more specialization occurs there are larger and larger numbers of individuals removed from natural to artificial conditions of existence. Not only so, but many of them are so far removed that they cease to have any knowledge of natural existence and so become entirely out of sympathy with those who retain some contact with and some interest in the natural order of things. This remoteness from nature may be physical as in the city dweller, or mental as in the rural resident who sees nothing but a pecuniary return through manipulation of same natural object. Thus it happens that the abilities of the naturalist tend to be obscured, ignored or derided in a complex society. His standing amongst his fellows is reduced to the lowest rank and his influence

[1] Read at the meeting of the Bay Section of the Western Society of Naturalists, Stanford University, November 29, 1918.

nears the vanishing point. It requires peculiar devotion to a cause to face such obscurity and indifference hence those who chose to be naturalists under such conditions are often seclusive, reticent and even indifferent to interests of others.

In recent years there has been a good deal of discussion of the need of considering the wholeness of organisms, of organizations of various social groups, etc. Every one seems ready to concede that we do not know a thing until we know all its relationships and that we do not know an organism or an organization until we know all its component parts. Every one seems willing to concede in the abstract that an organism is not complete if even the smallest part be missing or the obscurest function impaired. Practically when it comes to cases this view is not fully sustained as is well illustrated in case of the naturalist whose talents are insufficiently used and whose valuable point of view is largely ignored. The community as a whole suffers material loss from his submersion.

At this point it may be well to raise the question as to the proper status of the naturalist in our own social order. Should he be expected to take the highest place in leadership? Or a secondary place? Or should he be denied any leadership at all? Intelligent answer to such questions requires some examination of the naturalist's worth to his community or to society at large. Typically a statement of this worth may be brought under the following heads. (1) He may make discoveries which will extend the sources for food, clothing, transportation and manufacture. (2) He may make discoveries which enable better preservation and greater conservation of resources in health and wealth. (3) He may make discoveries which will enable better understanding of the fundamental laws governing the activities of all living things. (4) With his broad outlook he may so organize all available knowledge as to obtain better development of natural resources and better distribution and use of natural products. (5) He may so systematize useful information as to make essential features readily available for specialists with limited time and restricted outlook. (6) He may so condense, simplify and popularize available information as to make it not only usable but to some extent tasteful to those unskilled in scientific thought. Thus the sympathy of his fellows may be extended and their positive support secured. (7) He may be on the lookout for young people with ability who need encouragement to proceed along lines of study in natural history and he may so encourage them. (8) Last, but not least, he may himself give time consistently and regularly to consideration of the problems of his community and of society at large and he may then exert his voice and influence for the things which from his broad viewpoint appear right. Thus he may to some extent act as a balancing power even though he may not have or care to exercise powers of aggressive leadership.

From the foregoing it must appear that the naturalist should be accorded and that he should be willing to assume a place of very considerable importance in our social order. The character of this place will vary materially with conditions. In a small community existing under very simple conditions a naturalist of even modern abilities might be expected in most cases to be dominant in leadership. In a larger, more complex community only one of exceptional ability might reach great prominence. In such a community the naturalist of moderate ability would probably be limited to exerting influence in various ways. His efforts might bring larger results and his life accomplish more than in the smaller community though obscured by his relatively less importance. Here and there are a few naturalists of sufficient general ability to assume leadership in national affairs. It is a matter of great importance that they should be encouraged to do so.

This paper must further concern itself mainly with the naturalist of moderate ability, limited opportunities and restricted field, that is to say the ordinary sort. It seems to me that he ought to be encouraged to think of himself as having an obligation to the community, an obligation beyond the direct results of his scientific work, the obligation of

personal activity and interest in community affairs. This interest might be manifested by public and private discussion of public problems and community affairs. In such discussions the naturalist is peculiarly equipped for seeing the necessity of complete analysis of a question since he himself is repeatedly confronted with complex situations due to a multitude of factors, all of which must be more or less accurately evaluated. He is also able to see the need of giving time for a situation to develop itself since he is so familiar with the fact that Nature is unhurried in her operations whether their duration be seconds or ages. He is able to see the need of caution and accuracy in procedure since he is so frequently confronted with errors due to the impossibility of eliminating chance combinations. That is to say, the naturalist is able to bring to the consideration of a problem those methods which tend to accuracy of judgment and clarity of vision. Certainly any individual who can do this in a community should exert a valuable influence.

Since the members of a highly specialized community have a marked tendency to become narrow, one-sided, and so, to a considerable degree, abnormal, it is very necessary to have some influence in the other direction. This, too, the naturalist may be able to supply to a great extent. Popular talks on natural phenomena in connection with schools, churches or other organizations may be made of value. Pictures may be largely used for this purpose. Ordinary conversations may often be turned to advantage along this line. Simple exhibits of various sorts may be possible. Any method which will induce even superficial acquaintance of the general public with the great world of life is of distinct advantage from the standpoint of the human community however it may be from the scientific standpoint. Note particularly in this connection that the beneficial effect is reciprocal, *i. e.*, the narrow are broadened, the one-sided more rounded and the abnormal made more nearly normal on the one hand, while on the other hand the naturalist is stimulated, pleased and supported in his work, both financially and morally in a way not before possible.

Since there may be some who are still wondering what is the object of this paper I may call attention to the fact that we have to-day some very strong evidence pointing to the view that the day of individualism is rapidly passing and that the day of collectivism (of some sort) comes on apace. It is no more permissible for the man of science to shut himself up in his own interests and to assume an air of lofty indifference to the aims and aspirations of other people than it is for the business or professional man to do so. It is time for the man of science to take some cognizance of public affairs and to assume an active part therein, however small, no matter how much he may be tempted to go into his laboratory or his woods and fields and to ignore the general interests of humanity. It seems to me not at all beneath the dignity of such a body as this to consider ways and means of getting in closer touch with the people about us, of arousing their interest in us and our interest in them, and thus contributing our share toward the harmonizing of society as a whole. I feel certain that there are hundreds of people in this state who ought to have some interest in some or all of the things which we as individuals are doing. I think our state would be a better state if there were some understanding of that sort. It seems to me that we are too much disposed to let the especially able men like Dr. Jordan, Dr. Ritter, Dr. Evermann and others do what they can and to feel that we ourselves are thereby relieved of obligation. I do not think that is a correct attitude. If we want to have the general public respond as it should to the call for progress in scientific matters, we must each be willing to sacrifice some prejudice, some leisure and some effort for the good of the cause. I think too that we should collectively look over the field and consider the possibility of instituting or extending some activity that will help. What I have said simply indicates some of the lines along which I think activity might possibly be directed.

In conclusion, let me say that I think the naturalist ought to fill in his community a place of influence or of leadership, that be-

cause of his qualifications he ought, if necessary, to seek such a place, and that an organization of naturalists ought to definitely consider ways and means of extending its influence as far as possible.

This is a day of propaganda. The unworthy type will prevail if it is not overridden or displaced by the worthy type. Any and every learned society is under constructive obligation to do what it can in such a cause, but we must always remember the danger of attempting anything of the sort without first eliminating all traces of pedantry.

W. E. Allen

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La Jolla, Calif.

CHARLES CONRAD ABBOTT AND ERNEST VOLK[1]

The recent death of Dr. C. C. Abbott and Mr. Ernest Volk[1] of Trenton, New Jersey, removes two investigators whose work must always occupy a prominent place in attempts to estimate the conditions and chronology of prehistoric man. Not long after the discovery of palæolithic implements in northern France and southern England establishing the existence of man in Europe before the close of the Glacial period, Dr. Abbott began reporting the discovery of implements of similar type in the gravel deposits of glacial age upon which the city of Trenton is built. The first report of his discoveries was made to the Smithsonian Institution in 1875. Between 1875 and 1888 he had found sixty such specimens in the undisturbed gravel at various depths, some of which were as much as twenty-two feet from the surface.

As a resident of Trenton, Mr. Volk's attention was naturally called to Dr. Abbott's discoveries at the outset; but it was not until the fall of 1889 that he began systematic work, under the direction of Professor Putnam, for the Peabody Museum of Harvard University. His services continued for twenty-two years. The result of his long exploration of the Trenton gravels was published in 1911, in Volume V. of the Papers of the Peabody Museum of American Archæology and Ethnology. The report proper fills 258 octavo pages, which summarizes his journals from 1889 to 1905, and after that gives his journal in full, in which every day's work is carefully recorded. This fills one hundred pages. There are one hundred and twenty-five photographic illustrations.

In 1880, I was requested by Professor Putnam and Asa Gray to visit Trenton in the interests of the Peabody Museum, to shed what light I could upon the character of the gravel deposits in which palæolithic implements had been found by Dr. Abbott. This I did in company with Professor Boyd Dawkins, of England, who was then in Boston giving a course of Lowell Institute lectures, and Professor Henry W. Haynes, who had made collections from all the fields in Europe and in Egypt where palæolithic implements are found, and with Mr. H. Carvill Lewis, a glacialist of the highest reputation, who afterwards was joined with me in the survey of the terminal moraine across the state for the Pennsylvania Geological Survey; and whose report on the Trenton gravels published as an appendix to Abbott's "Primitive Industry" establishes beyond question the late glacial age of the deposit. Since then I have visited the region almost every year and some years several times, and at two different times spent days together with a committee appointed by the A. A. A. S. to make explorations. It is therefore proper that I should speak in defense of the discoveries, especially of Dr. Abbott and Mr. Volk in view of the fact that persistent attempts have been made to discredit them.

The chief reason for doubting the accuracy of these observations appears to have been that while Dr. Abbott and Mr. Volk had made so many discoveries, hardly anybody else has made any. But to this objection it is sufficient to say that Dr. Abbott and Mr. Volk have had a thousand opportunities to make discoveries where other investigators

[1] A notice of Dr. Abbott's death was given in Science, September 12. Mr. Volk was badly injured in an automobile accident on September 15 and died without recovering consciousness, two days afterwards.

have had but one. The railroad station at Trenton is twenty or twenty-five feet below the surface of the gravel and for years the railroad was continuously at work in excavating the gravel for ballast until they had removed many acres, thus exposing new perpendicular faces of the gravel for inspection every day for several years. As it is the early bird that catches the worm, so it is the early observer who notes the facts, and Dr. Abbott was such an observer. Every day for years, and sometimes two or three times a day, as he went to and fro, he observed these excavations, and his eye soon became trained so that no facts could escape his observation.

At the same time Mr. Volk was engaged for twenty-two years, not only in observing excavations made by other parties but in personal excavations in which many acres were dug over to a depth of about four feet, and everything carefully observed and noted. Mr. Volk's investigations were at last rewarded by the discovery of part of the shaft of a human thigh bone, seven feet and a half below the surface, where there had been no disturbance of the strata. He photographed this in place; and soon after, in the same stratum, found fragments of a cranium. A recent lecturer of high reputation as an anatomist has attempted to discredit this last discovery of Mr. Volk on two considerations, first that he was too much of an enthusiast to make accurate observations; and secondly that this bone is of the type of the modern Indian and therefore could not be so old as glacial gravels are supposed to be.

In answer to this it is sufficient to refer the reader to Mr. Volk's report just mentioned, which is all in the most plain and matter-of-fact style and is accompanied by one hundred and twenty-five plates made from his photographs. If ever I associated with an investigator who attempted to state facts just as he saw them, it was Ernest Volk. The principal reason for discrediting Mr. Volk's discovery is a theoretical one which is far from being established. The critic thinks the bones belong to a race more recent than the glacial deposits. But in the first place, there are current grossly exaggerated estimates as to the date of the close of the Glacial period. The Swedish geologists are producing incontrovertible evidence that it is less than 7,000 years ago since the ice retreated from southern Sweden; and there is a respectable number of geologists of wide experience in this country who think they have conclusive evidence that the close of the Wisconsin epoch in America occurred less than 10,000 years ago. In the second place Dr. Keith, the leading comparative anatomist of England, maintains that present types of the human skeleton go back in Europe to very much earlier times than can properly be assigned to the Trenton gravel. The permanence of racial peculiarities is by no means a settled question. Instead of denying facts on the basis of a theory involving a rapid rate of change in specific anatomic characteristics, facts should be allowed to modify the theory.

There is also abundant circumstantial evidence of the most positive kind sustaining the testimony of Dr. Abbott and Mr. Volk. For example, with two or three exceptions (which prove the rule), all the artifacts reported by them as found in the Trenton gravels below the disturbed surface of ten or twelve inches are of palæolithic type and made from argillite; while in the upper ten or twelve inches innumerable artifacts are found of modern Indian type, chipped from flint and jasper, with an occasional piece of pottery. This proves conclusively that the argillite implements belong to the original stratification of the gravel. No reason can be given for intrusive burials of argillite that would not be accompanied also by flint and jasper. Some, however, had supposed that these argillite fragments had worked down into the lower strata through the decayed roots of trees, or through holes made by burrowing animals, or through disturbances of the soil by the overturning of trees, or through cracks in the soil that occur in dry weather. All these theories have been urged; but this soil does not crack in dry weather, and the argillite fragments are larger and lighter than the flint and jasper and would not so readily follow down the cavity of

decayed tree trunks as would the other materials.

In 1897 I was asked by the A. A. A. S. to go down with a committee of the Society to inspect Mr. Volk's work. This I did in company with Mr. H. C. Mercer, Professor Arthur Hollick, of Columbia University, and Professor William Libbey, of Princeton. Five days were spent upon the ground. Mr. Volk ventured (what is a very hazardous thing for a scientific man to do), to prophesy what we should find. He let us select our ground, which we did in several places, and had extensive excavations made under our own eyes. What Mr. Volk prophesied was that in the upper foot of disturbed soil we should find numerous artifacts of flint and jasper and some pottery, but that below that we should find nothing of that kind but would find occasionally worked pieces of argillite. This proved to be exactly the case. We found in the lower portion of our excavation sixteen chipped fragments of argillite, all covered with deep patina. We found also some broken pebbles which had been battered to indicate use by man. We also found five flakes of quartz which may have been used as implements but were of an entirely different type from those on the surface. All this accorded with the general facts as reported by Mr. Volk, and to us were perfectly convincing evidence of the accuracy of his observations, and confirmatory of the testimony of Dr. Abbott concerning the prevalence of argillite in the undisturbed glacial strata, establishing a sharp distinction between the occupation of palæolithic man and that of the aboriginal Indians.

The work of Dr. Abbott and Mr. Volk illustrates the importance of having local observers interested in discoveries to be made about their own doors. They were both business men who turned aside to make and record observations which could be made only by those who were on the ground; and their observations have been carefully recorded and published, and their collections preserved where they are open to the observation of all scientific men, namely in the Field Museum of Natural History in Chicago, the American Museum of Natural History in New York City, but more than anywhere else in the Peabody Museum in Cambridge, Massachusetts. Aside from the volume already noted, Mr. Volk published reports of his early discoveries in the proceedings of the A. A. A. S. in 1894 and in the *Mem. Intern. Congress Anthropology*, 1894. In addition to "Primitive Industry" Abbott's discoveries are recorded in *Rep. Smithsonian Inst.*, 1875; "The Stone Age in New Jersey," 1877; *Rep. Peabody Museum*, 1877 and 1878; *Proc. Boston Soc. Nat. Hist.*, 1881 and 1883; *Am. Naturalist* (Extra), 1885; *Proc. A. A. A. S.*, 1889; *Archæologia Nova Cæsarea*, 1907, 1908, 1909.

G. FREDERICK WRIGHT

OBERLIN,
October 6, 1919

SCIENTIFIC EVENTS

INTERNATIONAL SCIENCE AND THE WAR

AN appeal has been addressed to the members of the academies of the allied nations and of the United States by 177 members of the academies of neutral nations—Holland, Norway, Sweden, Denmark, Finland and Switzerland—represented in the International Association of Academies, the opening and concluding paragraphs of which are as follows:

In the autumn of 1813, when for years a most bitter war had been raging between France and England, the English chemist Humphry Davy set out for Italy via Paris. His biographer relates what follows about his experiences in the French capital: "Nothing could exceed the cordiality and warmth of Davy's reception by the French savants. On Nov. 2nd he attended a sitting of the First Class of the Institute and was placed on the right hand of the President, who announced to the meeting that it was honoured by the presence of 'le chevalier Davy.' Each day saw some reception or entertainment in his honour. . . . On Dec. 13th, 1913 he was with practical unanimity elected a corresponding member of the First Class of the Institute."

On October 2, 1918, when a most bitter war raging between France and Germany for four years had practically come to an end, it is stated in a meeting of the French Académié des Science, that "elle a été unanime à déclarer que les relations personnelles sont pour longtemps impossibles entre les savants des pays alliés et ceux des empires cen-

traux," so that "nous devons abandonner les anciennes associations internationales, et en créer de nouvelles entre alliés avec le concours eventuél des neutres."

Whence this painful contrast? We should rather have expected the opposite, even without indulging illusions with regard to the progress of mankind during a hundred years. For there seems to be more room for generosity when the war's misery is past than when it is still raging; more too towards a defeated enemy than towards one who is still to be feared.

. . . .

Summing up what precedes we ask you earnestly and urgently: Recover your former selves. Recover the high scientific point of view which, on his deathbed, made Ampère say to a fellow worker: "il ne doit être question entre nous que de ce qui est eternel!" Once more: we understand how your attention of late has been monopolized by what is temporal and transitory. But now, you more than all the others, are called upon to find again the way to what is eternal. You possess the inclination for objective thought, the wide range of vision, the discretion, the habit of self-criticism. Of you we had expected the first step for the restoration of lacerated Europe. We call on you for cooperation in order to prevent science from becoming divided, for the first time and for an indefinite period, into hostile political camps.

THE LEAGUE OF RED CROSS SOCIETIES

We learn from *The British Medical Journal* that the headquarters of the League of Red Cross Societies, which was formed in Paris, on May 5, 1919, are at 9, Cour de St. Pierre, Geneva, and the work of organization is proceeding as rapidly as possible. The founder members of the League were the American, British, French, Italian and Japanese national Red Cross societies. The following national societies have since become members, Argentina, Australia, Belgium, Brazil, Canada, China, Cuba, Denmark, Greece Holland, India, New Zealand, Norway, Peru, Portugal, Rumania, Serbia, South Africa, Spain, Sweden and Venezuela.

The third number of the *Bulletin* of the League gives a list of the officers and heads of departments who have already been appointed and have taken up their duties at head quarters. The director-general is Lieutenant-General Sir David Henderson; the secretary-general is Professor William E. Rappard; the treasurer-general is M. André Pallain; the general medical director is Colonel Richard P. Strong, with Dr. Leonard Findley as director of the department of child welfare; the counsellor in international public health is Professor Rocco Santoliquido. In the departments of public health and hygiene bureaus will be organized to deal with the subjects of child welfare, tuberculosis, malaria, preventive medicine, venereal diseases and nursing.

An Inter-Allied Medical Commission was recently sent by the League at the request of the Polish government to investigate the pandemic of typhus fever in Poland. One of the gravest consequences of the devastation of Poland during the war has been the great decline in the sanitary condition of the Polish population, with a concurrent rise in the general mortality. The Inter-Allied Commission will report on the sanitary conditions in Poland, and will make recommendations as to the advisability of establishing sanitary cordons to suppress the spread of typhus into adjacent territories. When the commission has issued its report the League will be in a position to devise relief and preventive measures in the countries concerned, to propose to the Red Cross societies interested in the work an active sanitary campaign, and to urge the necessary measures that should be undertaken by the governments themselves. It is believed that the Polish pandemic of typhus originated in Russia and Ukrania.

The reports of the various sections of the medical conference held at Cannes in April last have now been published. They are printed in English, French, Italian and Spanish, and may be had on application to the Department of Information and Publication of the League.

THE TARIFF ON SCIENTIFIC APPARATUS

The *Journal* of the Washington Academy of Sciences states that the finance committee of the Senate, which has had before it the bill for a tariff on scientific supplies (H. R. 7785), decided on October 3 to postpone all

revenue and tariff matters until after the treaty of peace had been acted upon.

During the hearings on the bill the Tariff Commission prepared a report entitled *Information concerning scientific instruments*, which has been recently published. The report brings together a large number of opinions and arguments concerning the tariff on scientific supplies, received from various sections of the Bureau of Standards, from manufacturers and instruments of all kinds and from universities and organizations.

Two distinct questions are involved: (1) Should Congress repeal the privilege, now granted to institutions of learning, of importing supplies free of duty? (2) Should the present rates be increased and imported articles now on the free list be taxed?

The opinions quoted are not analyzed in the report, but the following brief outline will indicate that those interested are still far from being in agreement. (Definite recommendations only are counted.)

1. Of eleven university professors quoted, one favors and ten oppose repeal of the duty-free clause. Of twelve opinions from the Bureau of Standards, five favor and seven oppose repeal. Of seven manufacturers quoted on this subject six favor and one opposes repeal. The Council of the American Chemical Society is quoted in favor of repeal of the duty-free clause, "for a reasonable period of years, at least."

2. Opinions on the subject of the imposition and increase of tariff rates on scientific supplies are quoted as follows: Ten manufacturers, all in favor of higher tariff; eleven sections of the Bureau of Standards, seven in favor and four against. The commission believes that "the extremely diverse nature of the products falling under such a general designation as 'scientific instruments' renders general statements concerning the entire group of little value for the purpose of deciding on any rates of duty related to the competitive conditions which affect individual instruments."

The report also discusses in a general way the status of the domestic industry, imports and exports, tariff history, competitive conditions, and war developments.

THE NEW YORK BOTANICAL GARDEN

There was formally opened at the New York Botanical Garden on November 8 a new Central Display Greenhouse, the gift of Daniel and Murray Guggenheimer, erected at a cost of $100,000. The gift includes, besides the main house, an adjoining orchid house. The main building is approximately 140 feet long, forty-five feet wide and thirty-five feet high. Among its new features is the glass, which is frosted, thus doing away with the use of screens, previously considered necessary in glasshouses, although more or less of a disfigurement, as they become quickly defaced. The new building has an open concrete floored center, where lectures are to be given.

The central display house will contain plants from South Africa, the southern part of Japan, from South America and from some of the southern states in this country. A special exhibition of plants and flowers was shown. The Horticultural Society of New York held a large flower show in the new greenhouse which is now open to the public. It is on the eastern end of the grounds, near the Allerton Avenue subway station, and will aid in distributing the crowds visiting the gardens, the other group of greenhouses being at the western end of the grounds.

W. Gilman Thompson, president of the board of directors of the garden, opened the exercises and told of the educational work of the garden, a part of which will now be done in the new building. The gift of the greenhouse, he said, with the exception of one by Mrs. Russell Sage, was the largest ever made to the garden. Dr. N. L. Britton, director of the Botanical Garden, and Dr. D. T. MacDougal, director of botanical research, Carnegie Institution of Washington, formerly assistant director made addresses.

GIFT TO THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

Announcement is made that Mr. John D. Rockefeller has added $10,000,000 to his previous endowment of the Rockefeller Institute for Medical Research. This gift, the largest made by Mr. Rockefeller at one time to the institution, is to meet rapidly growing needs in its many lines of research and in

making new knowledge available in the protection of the public health and in the improved treatment of disease and injury.

By this increase in the endowment, new lines of research will be sustained in biology, chemistry and physics, upon which medical science so largely rests, as well as in medicine itself, as will the study of many practical problems directly relating to diseases in men and animals which are already under way.

The local activities of the Rockefeller Institute in New York are chiefly carried on in the great laboratories and the hospital, which stand high on the bluff facing the East River, between East 64th and 67th Streets, a part of the old Schermerhorn Farm of an earlier day.

Near Princeton, N. J., the institute has a large farm, where it maintains a department of animal pathology. The laboratories and various accessory buildings here are devoted to research on the diseases of animals and effective methods for their prevention and cure, as well as to the study of the bearing of animal diseases upon the health and economic interests of man.

The scientific staff of the Rockefeller Institute numbers sixty-five, most of them highly trained and of large experience in the subjects to which they are exclusively devoted. The institute further employs 310 persons in its technical and general service. It is to the perpetual maintenance of such a group of men and women, with adequate facilities and suitable conditions for their successful work, for the general welfare, that the gifts of Mr. Rockefeller to the institute are devoted.

The scientific staff consists of members, associate members, associates and assistants. The members are:

Simon Flexner, pathology and bacteriology; director of the Laboratories.
Rufus Cole, medicine; director of the Hospital; physician to the Hospital.
Theobald Smith, director of the department of animal pathology.
Alexis Carrel, experimental surgery.
P. A. Levene, chemistry.
Jacques Loeb, experimental biology.
S. J. Meltzer, physiology and pharmacology.
Hideyo Noguchi, pathology and bacteriology.

SCIENTIFIC NOTES AND NEWS

Charles Henry Hitchcock, for forty years professor of geology at Dartmouth College, died on November 6, at Honolulu, aged eighty-three years.

Mr. Richard B. Moore, until recently stationed at the Bureau of Mines' experiment station at Golden, Colorado, has been appointed chief chemist of the bureau, to succeed Dr. C. L. Parsons.

The degree of doctor of philosophy has been conferred upon Dr. Bohumil Shimek, professor of physiological botany in the State University of Iowa, by the University of Prague in appreciation of his scientific work. Dr. Shimek lectured in Prague in 1914.

Vilhjalmur Stefansson has been awarded the La Roquette Gold Medal of the Geographical Society of Paris, in recognition of the discoveries made by the Canadian Arctic Expedition under his command during the years 1913–18.

The Royal Institute of Venice has awarded the Querini-Stampalia prize to Professor G. D. Birkhoff, of Harvard University, for his papers on "The restricted problem of three bodies," and "Dynamical systems with two degrees of freedom."

Professors P. Boutroux and J. H. M. Wedderburn returned from military service to Princeton University at the opening of the present academic year.

We learn from *Nature* that Mr. Francis Jeffrey Bell, who has just retired from the Natural History Museum under the age-limit, entered the service of the trustees in 1878, when the zoological department was still at Bloomsbury and Professor Owen the superintendent. Mr. Bell is emeritus professor of comparative anatomy in King's College, London, and he served for many years as one of the secretaries of the Royal Microscopical Society, the *Journal* of which he also edited. In 1898 he acted as general secretary of the International Congress of Zoology.

Professor S. H. Vines proposes to retire from the Sherardian professorship of botany

in the University of Oxford at the end of the current year.

MR. F. J. KATZ has been granted leave of absence from the Mineral Resources division of the U. S. Geological Survey in order to accept an appointment as expert special agent in charge of Mines and Quaries for the Bureau of Census. This arrangement is to insure close and effective cooperation between the two bureaus in the Fourteenth Census.

MR. O. J. R. HOWARTH, assistant secretary of the British Association for the Advancement of Science, is making a collection of materials for a history of the association.

MR. JOHN B. FERGUSON has presented his resignation from the Geophysical Laboratory, Carnegie Institution of Washington, to be in effect November 1, and has accepted a research position with the Western Electric Company in New York City.

CHARLES BARTO BROWN has resigned as professor of civil engineering at the University of Maine and is now associated with The Frederick M. Ward Company in New Haven, Conn.

DR. F. W. SKIRROW, for the past four years assistant professor of chemistry at McGill University, has resigned this position to become chief chemist to the Shawinigan Laboratory, Ltd., the newly founded research organization of the Shawinigan Water and Power Co., Shawinigan Falls, Que.

DR. W. W. ROBBINS has resigned as professor of botany and botanist at the Colorado Agricultural College and Experiment Station to accept a position in the experimental department of the Great Western Sugar Company, with headquarters at Longmont, Colorado.

MR. BERRY V. BUSH, formerly head of the chemistry department at Friends Central School, Philadelphia, has been appointed research chemist in the organic research laboratories of the Eastman Kodak Co., Rochester, N. Y.

DR. L. A. BAUER, after returning to England from his eclipse expedition to Cape Palmas, Liberia, represented the United States Weather Bureau at a preliminary conference of directors of government weather bureaus of allied and neutral countries, called by Sir Napier Shaw at the British Meteorological Office, July 3–9. Later, as one of the United States delegates, he attended the meetings of the International Research Council and of the International Geodetic and Geophysical Union at Brussels from July 18 to 30. Since his return to the United States at the end of August, he has presented papers before various societies on the eclipse of May 29, 1919, and his experiences in Liberia. On December 2 he will deliver an illustrated lecture before the Royal Astronomical Society of Canada and the University of Toronto on the eclipse of May 29, 1919 and the researches of the Department of Terrestrial Magnetism. Besides photographs secured at his own station at Cape Palmas, he has received copies of photographs from the various expeditions along the belt of totality, from Bolivia to the French Congo.

JAMES R. CRAWFORD, of New York, one of the two members of the Stefansson Arctic expedition who were left on Banks Island two years ago, has arrived from the far north on the auxiliary schooner *Herman*. Mr. Crawford told of the hardships he endured during his forced stay of two years on Banks Island. His one attempt to reach the mainland in a small launch left by Mr. Stefansson met with failure in the ice floes.

DR. O. OLSEN proposes to conduct a small Norwegian anthropological and botanical expedition to Siberia next spring. His plan is to go to the Yenisei valley north of Krasnoyarsk, and to push thence into the less known regions immediately to the east.

THE tenth course of lectures on the Herter Foundation is being given at the Johns Hopkins University by Henry Hallett Dale, F.R.S., director of the department of biochemistry and pharmacology, Medical Research Committee on National Health Insurance, London. The subjects of the three lectures are: November 13, "Capillary poisons and shock"; November 15, "Anaphylaxis"; November 15, "Chemical structure and physiological action."

Professor I. Newton Kugelmass, head of the department of chemistry in Howard College, addressed on November 1 some of the southern chapters of the American Association of Engineers at the general meeting under the auspices of the Birmingham chapter on "Associationometry."

A monument erected in memory of Surgeon-General George Miller Sternberg, at the National Cemetery, was unveiled on November 5, and remarks were made by Surgeon-General Merritte W. Ireland, U. S. Army, Brigadier-General Walter D. McCaw, Colonel Edward L. Munson and Colonel Frederick F. Russell, Army Medical Corps, and Dr. George M. Kober, of the George Washington University.

The Weir Mitchell oration was delivered by Dr. Charles W. Burr, at the College of Physicians of Philadelphia, on November 1. The subject was "Dr. S. Weir Mitchell as a physician, a man of science, a man of affairs, and a man of letters."

UNIVERSITY AND EDUCATIONAL NEWS

Two industrial fellowships in the department of botany have just been established by the Gypsum Industries Association at the University of Chicago. Each fellowship provides a stipend of $750 and also $300 for the purchase of special material and apparatus. The Fleischmann Company has renewed the fellowship in the department of physiological chemistry which was established in 1917. The income of the fellowship provides $750 a year for two years.

Dr. Walter L. Niles, of New York, has been appointed dean of the Cornell Medical School in New York City, to fill the place left vacant by the death of Dr. William M. Polk.

Thomas Smith, lately professor of physics and head of the department of physics in the division of industries of the Carnegie Institute of Technology, has accepted the position of assistant professor in the department of mechanical engineering of the Massachusetts Institute of Technology. Professor John David, formerly assistant professor of physics in the division of industries of the Carnegie Institute of Technology, has been appointed professor of physics in Adelphi College, Brooklyn, N. Y.

Dr. R. R. Renshaw, formerly associate professor of organic chemistry at Iowa State College, has accepted an assistant professorship of chemical research in pharmacology at the Harvard Medical School, Boston.

Dr. Harold Hibbert, of Mount Vernon, New York, has accepted an appointment of assistant professor of chemistry in Yale University. Dr. Hibbert's work will be chiefly in the graduate school, where he will assist Professor T. B. Johnson in the teaching of organic chemistry and directing advanced research in this subject.

It is announced in *Nature* that a new chair of physical chemistry has been established in the University of Bristol on the endowment of Lord Leverhulme. Captain J. W. McBain, lecturer in physical chemistry in the university since its foundation, has been appointed to the chair.

DISCUSSION AND CORRESPONDENCE

SUBSTITUTES FOR THE WORDS HOMOZYGOUS AND HETEROZYGOUS

To the Editor of Science: Those who have attempted to explain the fundamentals of genetics to live-stock breeders and to others with a natural distaste for terminological refinements are aware how ineffective some of the available nomenclature is for this purpose. A technical word to be successfully applied to a new idea in a non-technical discussion must suggest its meaning readily, must be free from misleading connotations and should be sufficiently novel so that the point will not be missed by the audience owing to a spurious aspect of familiarity. That the words homozygous and heterozygous are admittedly defective on the first count is shown by the number of evasions to be found in the literature, but it has not been generally recognized that all their substitutes in common use fail in the other two particulars. To prove this statement requires little more than a list

of the common substitutes. For homozygous these are pure and pure-bred and for heterozygous, impure, mixed, hybrid, mongrel,[1] and cross-bred. These terms all designate, rather loosely to be sure, types or methods of mating or progeny of particular matings. The objections to the appropriation of these terms by Mendelists are many. Mendelists do not hold that a knowledge of an individual's origin is an accurate guide to its breeding behavior; the terms indicate that they do. The careless handling of these expressions causes needless concern to those interested in maintaining pure-bred stock, the very class of persons with whom geneticists should set up cordial relations. Confusion results from the dual meanings since in spite of the attempted re-definitions, it is still necessary for geneticists to speak of the different types of mating in the time-honored way. It is absurd to use impure or hybrid in treating of sex-linked inheritance and other forms of obligatory heterozygosis associated with pure breeding. The familiarity of these expressions make it appear that there is nothing particularly new in the distinction between homozygosity and heterozygosity, the recognition of which is perhaps the chief practical addition of genetics to the breeder's store of ideas. The indictment might be further extended, but enough has been said to show that the objection to these substitutes is not captious, but based on practical considerations.

I recognize that the use of these terms began with the early Mendelian work on plant material. The practise perhaps does not appear incongruous to the plant breeder, but it is time that the well-meaning popularizer should be made to realize that from the standpoint of animal breeding these words have much the same kind of appropriateness as "registered" would have as a substitute for homozygous and "grade" as a substitute for heterozygous. The sooner the misfits are banished, the sooner will we see the spread of a sensible appreciation of genetics in live stock circles. The need of discarding them far outweighs any possible inconvenience that would result from the necessary use of homozygous and heterozygous on all occasions, but the task would be lightened if a satisfactory series of alternatives were available for popular discussions. The object of this communication is to point out that by reviving and extending a usage introduced by Mendel himself, we can readily secure such a series.

Early in his 1865 paper, after demonstrating the 3:1 ratio, Mendel makes his first distinction between homozygotes and heterozygotes in these words: "Das dominirende Merkmal kann hier eine doppelte Bedeutung haben, nämlich die des Stammcharakters oder des Hybridenmerkmales." Throughout the paper he consistently refers to heterozygotes as hybrids—thus giving rise to our own unfortunate practise—but as soon as he has presented data showing the true nature of the F_2 ratio, he begins gradually to speak of the homozygotes, whether dominant or recessive, not as plants showing the parental character, but as those having the special trait of remaining constant in successive generations. "Sie besitzen nur constante Merkmale und ändern sich in den nächsten Generationen nicht mehr." His use of "constant" is indeed so insistent as to suggest that he intended to give to this adjective the technical meaning we attach to homozygous. Certainly our word might be substituted for his in passage after passage without making the slightest alteration in the sense or necessitating a textual change. Moreover in one place at least he makes constant a noun using it as the precise equivalent of homozygote. My suggestion is then that we follow Mendel in using *constant* for homozygous and homozygote, but that we use *inconstant* to replace his hybrid in the sense of heterozygous and heterozygote. The words *constancy* and *inconstancy* would then be available for abstract discussions, and if any one objected to the use of constant and inconstant as substantives, he could adopt

[1] Not common but used by Bateson on several occasions, including his address as president of the British Association for the Advancement of Science (1914). Employment of this term in America would add further to the undesirable implications owing to the bracketing of "scrubs and mongrels" in the stallion laws of several states

the expressions *constant form* (frequent in Mendels paper) ard *inconstant form.*

The proposed terms are simple, easily remembered and not spoiled by previous functioning in the literature of plant or animal breeding. They imply nothing as to the origin of the zygote, thus eliminating any possible suggestion that homozygous individuals necessarily arise from pure-breeding and heterozygous ones only from mixed breeding. The word constant conveys the valuable impression that there is a dependability in the germ cell formation of the homozygote, but it will be necessary to give warning that the word inconstant is not meant to suggest complete lawlessness in the breeding results of the heterozygote. However the word heterozygote itself and all substitutes hitherto proposed are defective in that none of them gives a hint as to the law of gamete formation in heterozygotes. While *inconstant* is thus open to the objection that it might convey misformation, it obviously emphasizes a point of essential importance to the breeder. Hybrid and other substitutes also require a word of explanation, since many hybrids are popularly supposed to breed true, but to retain such an impression would be worse than suggesting excessive irregularity. In short, the new terms if adopted would derive much of their value from the fact that a breeder will be quick to realize which kind of individual he wants in his herds or flocks and will thus be interested in knowing how the two types arise.

It is to be hoped that these two words or similar inoffensive ones will be accepted or at least not repudiated by professional geneticists. Some sort of agreement—either by common consent or by general indifference—will be necessary before the conscientious expounder may introduce the words to an audience without mentioning their technical equivalents.

Nothing in this note must be interpreted as a desire to displace homozygous and heterozygous or cognate forms from the technical literature.

Frank J. Kelley

States Relations Service,
U. S. Department of Agriculture

SOME PORT HUDSON OUTCROPS IN LOUISIANA

The Port Hudson beds, so named by Hilgard from their exposure at Port Hudson, La., consist for the most part of beds of clays, usually bluish or black but occasionally yellowish in color. At Port Hudson, La., the type locality, the lower beds consist of black to bluish tenacious clay with frequent logs, stumps and fragments of wood, mostly cypress. At St. Francisville, La., nine miles northwest of Port Hudson, the black, cypress bearing clays outcrop at Black Hill, one half mile east of the town with the following section:

20–25 feet of loess.

4 feet of waxy black and brown tenacious clay with fragments and limbs of cypress, Port Hudson.

2 feet of massive gray and brown sands with scattering sub-angular chert pebbles, probably Lafayette.

The upper beds of the Port Hudson were evidently eroded before the deposition of the loess. The black clay lies uncomformably on the Lafayette below with very sharp line of contact. Apparently the same black clay bed is to be seen in the bed of Scott Creek, near Laurel Hill, La., about 21 miles north of Port Hudson and 3 miles south of the La.-Miss. line. Evidently the lower Port Hudson beds in places underlie the western Florida parishes of Louisiana and probably also the adjacent southern counties of Mississippi.

F. V. Emerson

Louisiana State University

QUOTATIONS

THE RECOMPENSE OF SCIENTIFIC WORKERS

We are very glad to hear that the Science Committee of the British Medical Association has elected a sub-committee to confer with the British Science Guild and other bodies "in the matter of the inadequate recognition and recompense by the government and other bodies of medical workers in the field of science." We are also glad that the Science Guild is nominating some of its members to confer with this sub-committee of the British Medical Association. The members are as follows: For the British Medical Association,

Sir Clifford Allbutt, K.C.B., F.R.S., Dr. R. T. Leiper, Professor Benjamin Moore, F.R.S., Mr. E. B. Turner, F.R.C.S., Professor J. S. Haldane, F.R.S.; and for the British Science Guild, Professor Bayliss, F.R.S., and Dr. Somerville (Chairman and Secretary of the Guild's Health Committee), Sir Alfred Keogh, G.C.B., and Sir Ronald Ross.

We have called attention to this matter in *Science Progress* over and over again, without any definite result hitherto. There is unlimited talk just now about the encouragement of science, but the vital point is almost always omitted. This point is that, unless you make it worth their while for men of great abilities to investigate nature, they will in many cases not be able to do so even though they have the strongest inclination in that direction. We are now spending large sums of money for scientific work, but most of it goes in providing laboratory facilities and small salaries to junior men for "potboiler work." This is certainly essential, and we lodge no objection to such expenditure; but, in addition, we must pay adequately for the best possible brains. There is only one way to do so—by paying for discoveries which have already been made. There is really no other way of detecting the best possible brain when it exists. The proof of the pudding is in the eating, and, of the best brain, in the result obtained by it. We therefore think that the world should organize a system of pensions, not only for medical, but for all work which has been of great value to the public at large without being remunerative to the worker. Such a thing is only common sense, common justice and common morality.

The case of the medical scientific worker is the strongest of all. Few people recognize that medical science brings in almost no payment even when it results in discoveries which are really revolutionizing civilization. The fact is that, of all great events in history, perhaps none exceed in importance the discoveries made during the last century regarding the nature of human diseases and their prevention and cure. Yet the people who have made these discoveries have generally lived, we might almost say, in extreme poverty. We believe that the salaries of pathological professors amount generally to only a few hundred a year, and seldom, if ever, exceed one thousand pounds a year. Even these posts appear to be seldom given to men who have themselves made leading medical discoveries. Some people seem to think that such men are remunerated by medical practise; but that is far from the case, and anyway it is a poor kind of remuneration which is given only by means of additional work. For example, Jenner, the great discoverer of vaccination, found that his reputation in this line actually ruined his medical practise; and it was partly for this reason that early last century the British Parliament (which was then a rational and virile body) gave him £30,000 as a reward. The reason for this is that everyone considers a famous discoverer to be only a faddist or a charlatan! Of course many other pursuits which are invaluable to civilization are in precisely the same boat—other branches of science, music, literature and sometimes even painting, travel, etc. Our proposal is that every nation should keep a pension fund for really great work in these lines. We do not suppose that the British Empire would have to pay more than, say, £30,000 annually for such pensions, as against many millions of pounds which it now gives as a subvention for loafing, incompetence, and unemployment.—*Science Progress.*

SPECIAL ARTICLES

A METHOD OF ASSIGNING WEIGHTS TO ORIGINAL OBSERVATIONS

Persons accustomed to making precise measurements know that the circumstances attendant upon their work vary to such a degree as to render some observations much more reliable than others. When a series of such results is adjusted, as by averaging the measurements on a single quantity, it is logical that some should be given greater voice in deciding upon the most probable value. This is done by assigning to each observation a number, called its *weight*, which represents the relative degree of reliability of the observation in question. The practical

way of interpreting these weights is to give each observation a number of "votes," so to speak, equal to its weight; that is, to count its result that number of times in making up the average. An observation with weight 5, for example, is considered to be worth five times as much as one with weight 1, whatever that signifies. It merits as much confidence as the average of five observations with weight 1.

If each result to be weighted is actually the mean of a number of similar observations, the weighting is comparatively easy. But we refer to the weighting of the *original* observations; and how is one to decide, without indulging in mere guesswork, what this factor, to be assigned to each of such a series of results, should be?

Probably many scientific observers do not weight their measurements because they do not know how. They know that some results are much more trustworthy than others, but they are at a loss when it comes to expressing *how much* more. It is the purpose of this paper to suggest a simple means whereby any scientific worker may arrive at a consistent practise in this matter.

There are very few people engaged in work involving precise measurement who have not reached, through experience either as teachers or as students, a prety well defined interpretation of the ordinary percentage grades assigned to pupils in school or college. When a boy comes home with a grade of only 72 in grammar, the occasion is not one for congratulation. The whole family knows that 72 stands for poor quality of scholarship, for the reason that the vast majority of pupils are assigned a higher grade than this.

Now, it is not difficult for an observer to assign percentage grades to his experimental results, passing judgment upon them very much as he would upon work done by a student in laboratory or classroom. He may even take separate account of the various factors which may affect the observation, such as weather conditions, visibility, constancy of temperature, etc., and combine all these in estimating the final grade of the result, just as a teacher combines recitations, notebooks, tests and examination in grading a student.

And if, when the several observations of a set have been thus graded, a means is at hand to translate the grades into relative weights, our problem is solved. Such a means is provided by the following considerations.

The *variable* conditions attending the making of measurements, which alone affect their relative weight, are of course fortuitous. The experimenter tries to have everything constant and to maintain a uniformly high standard of precision, just as a marksman tries repeatedly to hit the same target. But he can not control all the conditions, and these fluctuate in accordance with the well-known law of departures, based upon the theory of probabilities.

The theory puts no limit to these fluctuations, and one observation might, theoretically, be a thousand times more reliable than another; but practically no such range need be considered. Probably for most purposes, primarily assigned[1] weights need not go outside the simple scale of integers from 0 to 10; the weight 0 denoting absolute worthlessness (observation to be discarded) and the weight 10 denoting practical certainty. Either of these cases would be extraordinary and of very rare occurrence. The general run of results will vary from a little doubtful to a little more than usually reliable, being situated not far either way from weight 5, the middle of the scale.

When the unit of weight has been chosen with such significance that the distribution is as described, it is possible at once to predict what proportion of observations should, in the long run, have weight 2, what proportion should have weight 3, etc. This is done by means of the *probability integral,* tables of which are given in most books on the theory of errors. These proportions are here given as percentages, accurate to the second decimal place:

1 This does not apply to weights computed for adjusted values based on long series of observations or upon indirect measurements of connected quantities. In such cases, large and even mixed fractional numbers may be consistently assigned as weights.

Percentage having weight	0 should be	0.00
" " "	1 " "	0.15
" " "	2 " "	1.54
" " "	3 " "	8.46
" " "	4 " "	23.42
" " "	5 " "	32.86
" " "	6 " "	23.42
" " "	7 " "	8.46
" " "	8 " "	1.54
" " "	9 " "	0.15
" " "	10 " "	0.00

For the present purpose it will be more useful to express these same data in the following form:

Percentage having weight—

0 *or above* should be	100.00
1 " " " "	100.00
2 " " " "	99.85
3 " " " "	98.31
4 " " " "	89.85
5 " " " "	66.43
6 " " " "	33.57
7 " " " "	10.15
8 " " " "	1.69
9 " " " "	0.15
10 " " " "	0.00

Now a similar tabulation may be made in the case of grades. An examination of the grades assigned by teachers shows a distribution which, while it is very far from having the bilateral symmetry of the theoretical departure law, nevertheless gives evidence of a somewhat similar continuous relation throughout the range of the assignment. The following data, based on the tabulation of over one hundred thousand grades from a large number of school and college teachers,[2] are probably fairly typical:

Percentage of grades which were—

50 *or above* was	100
55 " " "	99
60 " " "	98
65 " " "	96
70 " " "	94
75 " " "	89
80 " " "	83
85 " " "	70
90 " " "	56
95 " " "	32
100 " " "	9

[2] See article by author, "A Standard of Interpretation of Numerical Grades," *School Review*, Vol. XXV., p. 412, June, 1917.

Let us plot these two sets of data on the same diagram, so that they may be easily compared (Fig. 1). The method of translation from grades to weights may then be made

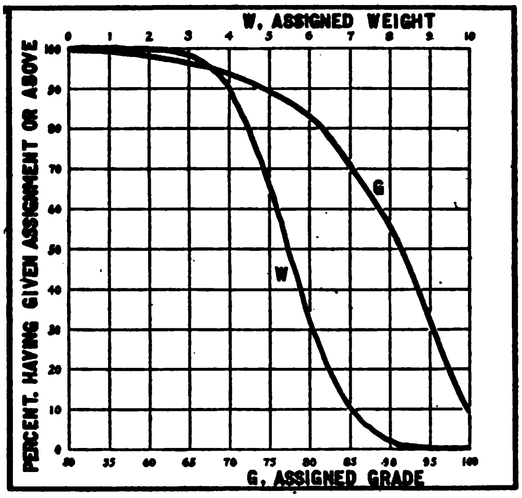

Fig. 1.

clear by a single illustration. The grade curve shows that the grade 85 *or above* is attained in 70 per cent. of all cases, while the

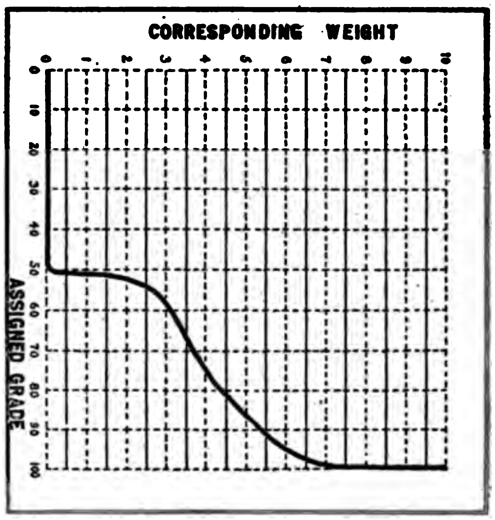

FIG. 2.

weight that should be attained in the same percentage of cases is shown by the weight curve to be 4.9 *or above*. It logically follows that the *grade* 85 corresponds to the *weight* 4.9; etc.

By obtaining a number of such corresponding points, the translation curve (Fig. 2) is constructed. Fractional weights being inconvenient, the most practical tabulation will probably be as follows:

TRANSLATION TABLE FROM PERCENTAGE GRADES TO WEIGHTS

Grades	Corresponding Weight
0– 50	0
50– 51	1
51– 54	2
54– 67	3
67– 82	4
82– 92	5
92– 97	6
97–100	7
100	8
Very exceptional	9
Practically certain	10

This table will serve our purpose in most cases. One further refinement may be desirable, especially if the observer suspects that his own habit in grading is far from normal; that is, if he is inclined to be either unusually severe or unusually lenient in assigning grades. The article previously referred to contains tables which afford the necessary correction. The writer, for example, is a grader of Type 6 as there classified, and in his case weight 5 corresponds to grades from 77 to 88, instead of from 82 to 92; etc. The difference will not usually be of extreme importance. A still better plan, when the observer makes and grades a very large number of similar observations, is to construct one's own grade distribution curve (corresponding to Fig. 1) from the tabulation of these gradings, and from it to prepare, as above explained, a translation table suited exactly to one's own peculiar grading characteristics.

Summarizing this method of assigning weights to original observations:

1. First grade the observations on a scale of 100 as you would students, averaging together the various factors that may affect their reliability. In doing this, endeavor to maintain the same mental attitude toward the experiments as you would toward the work of a class of students.

2. Then consult the above translation table (or one of your own making) for the proper weights to be assigned.

LEROY D. WELD

COE COLLEGE,
CEDAR RAPIDS, IOWA

THE AMERICAN CHEMICAL SOCIETY. III

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. S. Miner, *Chairman*

H. E. Howe, *Secretary*

Incendiaries used in modern warfare: CAPT. A. B. RAY.

Gas masks in the industries: A. C. FIELDNER. The Bureau of Mines is cooperating with the industries in the development of suitable modifications of the Army gas mask for industrial use. In the nine months that have elapsed since the signing of the armistice, the gas mask has made rapid progress in finding a wide application in protecting workmen from poisonous and irritating gases given off in various chemical operations; as for example, chlorine, phosgene, sulphur dioxide, oxides of nitrogen, hydrochloric acid, sulphur chloride and many organic vapors as carbon disulphide, benzol, carbon tetrachloride, aniline, chloroform, formaldehyde, etc. Fire departments have purchased many Army masks for use as smoke protectors. However, they must be used with caution around fires, as they given no protection from carbon monoxide, which may be present in smoky atmospheres. The Army gas mask, when fitted with special canister containing ammonia absorbents, has met with great success for use around refrigerating plants. On the whole, the gas mask is rapidly finding its proper place in the industries. It has not met all the requirements expected, especially in such cases where the workmen must wear it for long periods of time. Experience has shown that they simply will not wear a mask continuously if they can possibly get along without it, but for short periods and in emergencies, it has proved very useful. The possibilities of the gas mask principle are now pretty generally understood, and much improvement in design may be expected within the next year.

The physical character of hydrous ferric oxide: HARRY B. WEISER.

Modern commercial explosives: R. H. HILL. Paper disputes the war-developed, current idea

that explosives are necessarily connected with matters of a military nature and attempts to furnish a general knowledge of the modern condition of the industry for the busy man who would like such a general idea of it, but does not find time to review lengthy publications. Subjects discussed are black blasting powder, straight dynamites and gelatin dynamites, non-freezing straight dynamites and gelatin dynamites, ammonia or extra dynamites and gelatin dynamites, permissibles, miscellaneous dynamites and non-freezing dynamites. Strength bases are shown and strength comparisons between commercial dynamites and some important military explosives are given. Developments on lowering the freezing point of nitroglycerine are discussed. Mention is made of various matters requiring chemical or physical control in explosive manufacture and the necessity is shown for such control from the initial preparation of ingredients to the final results of the blast.

Chemicals received by the Bureau of Chemistry during the war: H. E. BUC. During the last four years about 1,300 shipments of chemicals from a large number of dealers and manufacturers have been tested in the Bureau of Chemistry. The greater part of the reagents bore an analysis on the label. Most of the chemicals examined are satisfactory. Occasional impurities are found often enough in chemicals from practically all manufacturers to make it necessary to test all shipments.

Report on the production of synthetic organic chemicals in the Research Laboratory of Eastman Kodak Co., 1918 and 1919: C. E. K. MEES.

SYMPOSIUM ON REFRACTORIES, A. V. BLEININGER, CHAIRMAN

The classification of refractories: G. H. BROWN.

Work of the Technical Department of the Refractories Manufacturers' Association: R. M. HOWE. The Refractories Manufacturers' Association has maintained a central refractories laboratory for over two years. This laboratory is located at the Mellon Institute of Industrial Research of the University of Pittsburgh and serves annually over fifty refractories companies. Small charges are made for the work done and this income makes the system practically self-supporting. The problems investigated are divided into two classes, viz., general and specific. The general problems are not discussed, but the specific problems encountered at different plants are considered briefly. These problems are met with from the time of purchasing a site until the shipment of each load of brick. The owners must know the extensiveness of a deposit before opening it up at a large expense. The miners must have abundant advance information concerning the physical properties of the different clays on the property: they must be able to reject or accept different clays by their hardness, color, structure, size of grain and location. The securing of such data requires the expenditure of considerable money, yet it seems to be justified due to the economical selection of clays, the production of a uniform product, and the avoidance of unjustified construction. The clays, after being mined, are used separately, or mixed with bond clays to secure strength; flint clay to increase the refractoriness and resistance to spalling; alumina to increase refractoriness; silica to decrease the tendency to spall and shrink, and grog for several reasons. After the mixes are fixed, they are worked with water. This is sometimes considered a minor step, but it is now established that the *amount* of water used in tempering plays an important part in determining the final structure of the brick. There is always one definite proportion which is most suited to the production of the densest brick. The *time* used in working clay also enacts an important rôle in determining the final structure a variation in strength amounting to 25 per cent. of the total having been observed when the time was varied. Draw trial curves, which illustrate the behavior of clays at different temperatures, are proving to be of value. They not only tell the manufacturer how his clays must be worked but inform the consumers how the bricks will behave in service. Other factors which concern the process of manufacture are too complicated to report but they can be and are being studied constantly.

The selection of refractories for industrial furnaces: W. F. ROCHOW. Economy in the use of refractories is governed by the selection of the class of material best suited for the purpose, the quality of the brick used and the design of the furnace. Thermal insulation is made practicable under severe temperature conditions by the use of silica brick because of their good mechanical strength at high temperatures. On burning, silica brick undergoes partial inversions from quartzite to cristobalite and tridymite. These inversions are accompanied by permanent volume increases. Recently it has been suggested that the lowering of the specific gravity of silica brick on changing from quartzite to the other crystalline forms, be used as a measure of the extent of this transformation and that well-burned brick should have a

specific gravity of not over 2.38. Some quartzites invert to cristobalite more slowly than others and brick with a lesser content of cristobalite have a lower spalling tendency and also do not show an appreciably greater permanent expansion when subjected to long-continued heating. Brick made from this type of quartzite may be properly burned when inversion has occured to such an extent that its specific gravity is slightly greater than 2.38. Examples with analyses are given. Metal-cased magnesite brick consist of steel containers of square or circular cross section, filled with dead burned magnesite. These are laid as headers in the furnaces. When heated the steel fuses and impregnates the magnesite forming a monolithic lining. Such a lining is more porous than one of magnesite bricks and has the advantage of better withstanding rapid temperature changes. Such bricks may be used in place of magnesia and silica brick in parts of the open hearth steel furnace and in electric steel melting furnaces.

Interesting facts concerning refractories in the iron and steel industry: C. E. NESBITT and M. L. BELL. In this paper the writers state the importance of refractories and emphasize the necessity for their greater efficiency in the iron and steel industry. This improvement can only be accomplished by the cooperation of the producer and the consumer. In the manufacture of iron and steel, refractories meet a wide range of temperature, while destructive agencies such as acid, basic or neutral slags, severe thermal changes, load, abrasion, impact and expansion are present in varying degrees of severity. Tests on refractory brick, easily and rapidly executed, which show a close relation to actual service conditions were developed for determining the resistance to these destructive agencies. The most important working qualities can be determined by two or three tests namely the spalling and hot crushing tests for silica brick, and the spalling, hot load and slagging tests for clay brick. Variations in the life of blast furnace linings, open hearth roofs, converter bottoms soaking pits and ladle linings are mentioned. Results are given showing the marked decrease in crushing strength and increase in spalling of silica brick defective from fire cracks, poor moulding, poor slicking, etc. The writers show the close relationship of the spalling test results with the life obtained in open hearth roofs. The effect of the degree of fineness or size of particles in silica brick is illustrated by results of the spalling test. The effect on certain qualities of clay brick produced by the method of manufacture is illustrated by spalling and load test results. The effect of the degree of fineness and the reduction of strength by heating of clay brick is also shown. From the comparative data it is evident that refractories require most thorough study. Simple practical tests which can be run in quantity and which give data showing variations in quality which reflect on the life of the structure should be adopted. A more uniform product can be secured if a careful study is made of the variations in manufacture which effect the important qualities.

Superior refractories: R. C. PURDY.

Refractory problems in the gas industry: W. H. FULWEILER and J. H. TAUSSIG. In the coal gas process the temperatures range from 400° C. to 1500° C. Rapid changes in temperature and expansion must be considered. Silica material is used in the retorts and the combustion chamber. Fire clay material is used in the recuperators and where the temperature is below 1000° C. In the water gas process the temperature may be 1700° C. in the generator, together with the slagging action due to the ash from the fuel. Abrasion occurring in removing clinker is important. In the carburettor the checker brick are heated to 1200° C. and sprayed with cold oil. Fire clay is used in the generator linings, but other materials are being tried. Cements used in construction frequently do not receive proper attention. Laboratory tests are useful in controlling the quality of materials.

CHARLES L. PARSONS,
Secretary

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CONTENTS

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ATOMIC PROJECTILES AND THEIR COLLISIONS WITH LIGHT ATOMS[1]

THE discovery of radio-activity has not only thrown a flood of light on the processes of transformation of radio-active atoms; it has at the same time provided us with the most powerful natural agencies for probing the inner structure of the atoms of all the elements. The swift α-particles and the high-speed electrons or β-rays ejected from radio-active bodies are by far the most concentrated sources of energy known to science. The enormous energy of the flying α-particle or helium atom is illustrated by the bright flash of light it produces when it impacts on a crystal of zinc sulphide, and by the dense distribution of ions along its trail through a gas. This great store of energy is due to the rapidity of its motion, which in the case of the α-particle from radium C (range 7 cm. in air) amounts to 19,000 km. per second, or about 20,000 times the speed of a rifle-bullet. It is easily calculated that the energy of motion of an ounce of helium moving with the speed of the α-particle from radium C is equivalent to 10,000 tons of solid shot projected with a velocity of 1 km. per second.

In consequence of its great energy of motion the charged particle is able to penetrate deeply into the structure of all atoms before it is deflected or turned back, and from a study of the deflection of the path of the α-particle we are able to obtain important evidence on the strength and distribution of the electric fields near the center or nucleus of the atom.

Since it is believed that the atom of matter is, in general, complex, consisting of positively and negatively charged parts, it is to be anticipated that a narrow pencil of α-particles, after passing through a thin plate of matter, should

[1] An address before the Royal Institution of Great Britain, June 6, 1919.

be scattered into a comparatively broad beam. Geiger and Marsden showed not only that much small scattering occurred, but also that in passing through the atoms of a heavy element some of the α-particles were actually turned back in their path. Considering the great energy of motion of the α-particle, this is an arresting fact, showing that the α-particle must encounter very intense forces in penetrating the structure of the atom. In order to explain such results, the idea of the nucleus atom was developed in which the main mass of the atom is concentrated in a positively charged nucleus of very small dimensions compared with the space occupied by the electrons which surround it. The scattering of α-particles through large angles was shown to be the result of a single collision where the α-particle passed close to this charged nucleus. From a study of the distribution of the particles scattered at different angles, results of first importance emerged. It was found that the results could be explained only if the electric forces between the α-particle and charged nucleus followed the law of inverse squares for distances apart of the order of 10^{-11} cm. Darwin pointed out that the variation of scattering with velocity was explicable only on the same law. This is an important step, for it affords an experimental proof that, at any rate to a first approximation, the ordinary law of force holds for electrified bodies at such exceedingly minute distances. It was also found that a resultant charge on the nucleus measured in fundamental units was about equal to the atomic number of the element. In the case of gold this number is believed from the work of Moseley to be 79.

Knowing the mass of the impinging α-particle and of the atom with which it collides, we can determine from direct mechanical principles the distribution of velocities after the collision, assuming that there is no loss of energy due to radiation or other causes. It is important to notice that in such a calculation we need make no assumption as to the nature of the atoms or of the forces involved in the approach and separation of the atoms. For example, if an α-particle collides with another helium atom, we should expect the α-particle to give its energy to the helium atom, which could thus travel on with the speed of the α-particle. If an α-particle collides directly with a heavy atom—*e. g.*, of gold of atomic weight 197—the α-particle should retrace its path with only slightly diminished velocity, while the gold atom moves onward in the original direction of the α-particle, but with about one fiftieth of its velocity. Next, consider the important case where the α-particle of mass 4 makes a direct collision with a hydrogen atom of mass 1. From the laws of impact, the hydrogen atom is shot forward with a velocity 1.6 times that of the direction, but with only 0.6 of its initial speed. Marsden showed that swift hydrogen atoms set in motion by impact with α-particles can be detected like α-particles by the scintillations produced in a zinc sulphide crystal. Recently I have been able to measure the speed of such H atoms and found it to be in good accord with the calculated value, so that we may conclude that the ordinary laws of impact may be applied with confidence in such cases. The relative velocities of the α-particles and recoil atom after collision can thus be simply illustrated by impact of two perfectly elastic balls of masses proportional to the masses of the atoms.

While the velocities of the recoil atoms can be easily calculated, the distance which they travel before being brought to rest depends on both the mass and the charge carried by the recoil atom. Experiment shows that the range of H atoms, like the range of α-particles, varies nearly as the cube of their initial velocity. If the H atom carries a single charge, Darwin showed that its range should be about four times the range of the α-particle. This has been confirmed by experiment. Generally, it can be shown that the range of a charged atom carrying a single charge is mu^3R, where m is the atomic weight, and u the ratio of the velocity of the recoil atom to that of the α-particle, and R the range of the α-particle before collision. In comparison of theory with experiment, the results agree better if the index is taken as 2.9 instead of 3. If, however, the

recoil atom carries a double charge after a collision, it is to be expected that its range would only be about one quarter of the corresponding range if it carried a single charge. It follows that we can not expect to detect the presence of any recoil atom carrying two charges beyond the range of the α-particle, but we can calculate that any recoil atom, of mass not greater than oxygen and carrying a single charge, should be detected beyond the range of the α-particle. For example, for a single charge the recoil atoms of hydrogen and helium should travel 4 R, lithium 2.8 R, carbon 1.6 R, nitrogen 1.3 R, and oxygen 1.1 R, where R is the range of the incident α-particles. We thus see that it should be possible to detect the presence of such singly charged atoms, if they exist, after completely stopping the α-particles by a suitable thickness of absorbing material. This is a great advantage, for the number of such swift recoil atoms is minute in comparison with the number of α-particles, and we could not hope to detect them in the presence of the much more numerous α-particles.

In order to calculate the number of recoil atoms scattered through any given angle from the direction of flight of the α-particles, it is necessary, in addition, to make assumptions as to the constitution of the atoms and as to the nature and magnitude of the forces involved in the collision. Consider, for example, the case of a collision of an α-particle with an atom of gold of nuclear charge 79. Assuming that the nucleus of the α-particle and that of the gold atom behave like point charges, repelling according to the inverse square law, it can readily be calculated that, for direct collision, the α-particles from radium C, which is turned through an angle of 180°, approaches within a distance $D = 3.6 \times 10^{-12}$ cm. of the center of the gold nucleus. This is the closest possible distance of approach of the α-particle, and the distance increases for oblique collisions. For example, when the α-particle is scattered through an angle of 150°, 90°, 30°, 10°, 5°, the closest distances of approach are 1.01, 1.2, 2.4, 6.2, 12 D respectively.

In the experiments of Geiger and Marsden, the number of α-particles scattered through 5° was observed to be about 200,000 times greater than the number through 150°. The variation with angle was in close accord with the theory, showing that the law of inverse squares holds for distances between $3{\cdot}6 \times 10^{-12}$ cm. and $4{\cdot}3 \times 10^{-11}$ cm. in the case of the gold atom. The experiments of Crowther in 1910 on the variation of scattering of β-rays with velocity indicate that a similar law holds also in that case, and for even greater distances from the nucleus.

We have seen that Marsden was able by the scintillation method to detect hydrogen atoms set in swift motion by α-particles up to distances about four times the range of the incident α-particle. In Marsden's experiments a thin-walled glass tube filled with radium emanation served as an intense source of rays. Since the lack of homogeneity of the α-radiation and the absorption in the glass are great drawbacks in making an accurate study of the laws controlling the production of swift atoms by impact, I have found it best to use for the purpose a homogeneous source of radium C by exposing a disc in a strong source of emanation. Fifteen minutes after removal from the emanation the α-rays from the disc are practically homogeneous, with a range in air of 7 cm. By special arrangements very intense sources of α-radiation can be produced in this way, and in the various experiments discs have been used the γ-ray activity of which has varied between 5 to 80 milligrams of radium. Allowance can easily be made for the decay of the radiation with time.

In the experiments with hydrogen the source was placed in a metal box about 3 cm. away from an opening in the end covered by a thin sheet of metal of sufficient thickness to absorb the α-rays completely. A zinc sulphide screen was mounted outside about 1 mm. away from the opening, so as to allow for the insertion of absorbing screens of aluminium or mica. The apparatus was filled with dry hydrogen at atmospheric pressure. The H atoms striking the zinc sulphide screen were counted by means of a microscope in the

usual way. The strong luminosity due to the β-rays from radium C was largely reduced by placing the apparatus in a powerful magnetic field which bent them away from the screen.

If we suppose, for the distances involved in a collision, that the α-particle and hydrogen nucleus may be regarded as point charges, it is easy to see that oblique impacts should occur much oftener than head-on collisions, and consequently that the stream of H atoms set in motion by collisions should contain atoms the velocities of which vary from zero to the maximum produced in a direct collision. The slow-velocity atoms should greatly preponderate, and the number of scintillations observed should fall off rapidly when absorbing screens are placed in the path of the rays close to the zinc sulphide screen.

A surprising effect was, however, observed. Using α-rays of range 7 cm., the number of H atoms remained unchanged when the absorption in their path was increased from 9 cm. to 19 cm. of air equivalent. After 19 cm. the number fell off steadily, and no scintillations could be observed beyond 28 cm. air absorption. In fact, the stream of H atoms resembled closely a homogeneous beam of α-rays of range 28 cm., for it is well known that, owing to scattering, the number of α-particles from a homogeneous source begin to fall off some distance from the end of their range. The results showed that the H atoms are projected forward mainly in the direction of the α-particles and over a narrow range of velocity, and that few, if any, lower velocity atoms are present in the stream.

If we reduce the velocity of the α-particle by placing a metal screen over the source, it is found that the distribution of H atoms with velocity changes, and that the rays are no longer nearly homogeneous. When the range of the α-rays is reduced to 3·5 cm., the absorption of the H atoms is in close accord with the value to be expected from the theory of point charges. It is clear, therefore, that the distribution of velocity among the H atoms varies with the speed of the incident α-particles, and this indicates that a marked change takes place in the distribution and magnitude of the forces involved in the collision when the nuclei approach closer than a certain distance.

In addition to these peculiarities, the number of H atoms is greatly in excess of the number to be expected on the simple theory. For example, for the swiftest α-rays the number which is able to travel a distance equivalent to 10 cm. of air is more than thirty times greater than the calculated value. The variation in number of H atoms with velocity of the incident α-particle is also entirely different from that to be expected on the theory of point charges. The number diminishes rapidly with velocity, and is very small for α-particles of range 2·5 cm.

It must be borne in mind that the production of a high-speed H atom by an α-particle is an exceedingly rare occurrence. Under the conditions of the experiment the number of H atoms is seldom more than 1/30,000 of the number of α-particles. Probably each α-particle passes through the structure of 10,000 hydrogen molecules in traversing one centimeter of hydrogen at atmospheric pressure, and only one α-particle in 100,000 of these produces a high-speed H atom; so that in 10^9 collisions with the molecules of hydrogen the α-particle, on the average, approaches only once close enough to the center of the nucleus to give rise to a swift hydrogen atom.

We should anticipate that for such collisions the α-particle is unable to distinguish between the hydrogen atom and the hydrogen molecule, and that H atoms should be liberated from matter containing free or combined hydrogen. This is fully borne out by experiment.

From the number of H atoms observed it can be easily calculated that the α-particle must be fired within a perpendicular distance of $2{\cdot}4 \times 10^{-13}$ cm. of the center of the H nucleus in order to set it in swift motion. This is a distance less than the diameter of the electron, viz. $3{\cdot}6 \times 10^{-13}$ cm. The general results obtained with α-rays of range 7 cm. are similar to those to be expected if the α-particle behaves like a charged disc, of radius of about the diameter of an electron,

travelling with its plane perpendicular to the direction of motion.

It is clear from the experiments with hydrogen that, for distances of the order of the diameter of the electron, the α-particle no longer behaves like a point charge, but that the α-particles must have dimensions of the order of that of the electron. The closest distance of approach in these collisions in hydrogen is about one tenth the corresponding distances in the case of a collision of an α-particle with an atom of gold.

The results obtained with hydrogen in no way invalidate the nucleus theory as used to explain the scattering of α-rays by heavy atoms, but show, as we should expect, that the theory breaks down when we approach very close to the nucleus structure. In our ignorance of the constitution of the nucleus of the α-particle, we can only speculate as to its structure and the distribution of forces very close to it. If we take the α-particles of mass 4 to consist of four positively charged H nuclei and two negative electrons, we should expect it to have dimensions of the order of the diameter of the electron, supposing, as seems probable, that the H nucleus is of much smaller dimensions than the electron itself. When we consider the enormous magnitude of the forces between the α-particle and the H nucleus in a close collision—amounting to 6 kg. of weight—it is to be expected that the structure of the α-particle should be much deformed, and that the law of force may undergo very marked changes in direction and magnitude for small changes in the closeness of approach of the two colliding nuclei. Such considerations offer a reasonable explanation of the anomalies shown in the number and distribution with velocity of the H atoms exhibited for different velocities of the α-particles.

When we consider the enormous forces between the nuclei, it is not so much a matter of surprise that the nuclei should be deformed as that the structure of the α-particle or helium nucleus escapes disruption into its constituent parts. Such an effect has been carefully looked for, but so far no definite evidence of such a disintegration has been observed. If this be the case, the helium nucleus must be a very stable structure to stand the strain of the gigantic forces involved in a close collision.

We have seen that the recoil atoms of all elements of atomic mass less than 18 should travel beyond the range of the α-particle, provided they carry a single charge. Preliminary experiments, in which the α-particles passed through pure helium, showed that no long-range recoil atoms were present, indicating that after recoil the helium atom carries a double charge. In a similar way no certain evidence has been obtained of long-range recoil atoms from lithium, boron, or beryllium. It is difficult in experiments with solids or solid compounds to be sure of the absence of hydrogen or water-vapor, which results in the production of numerous swift H atoms. These difficulties are not present in the case of nitrogen and oxygen, and a special examination has been made of recoil atoms in these gases. Bright scintillations were observed in both these gases about 2 cm. beyond the range of the α-particle. These scintillations are, presumably, due to swift N and O atoms carrying a single charge, for the ranges observed are about those to be expected for such atoms. The scintillations due to recoil atoms of N and O are much brighter than H scintillations, although the actual energy of the flying atom is greater in the later case. This difference in brightness is probably connected with the much weaker ionization per unit of path due to the swifter H atom.

The corresponding range of the recoil atoms was about the same in oxygen, nitrogen and carbon dioxide. Theoretically, it is to be anticipated that the N recoil atom should give a somewhat greater range than the O atom. The recoil atoms observed in carbon dioxide are apparently due to oxygen, for if the carbon atoms carried a single charge they should be detected beyond the range of O atoms.

The number of recoil atoms in nitrogen and oxygen and their absorption indicate that these atoms, like H atoms, are shot forward mainly in the direction of the α-particles. It

is clear from the results that the nuclei of the atoms under consideration can not be regarded as point charges for distances of the order of the diameter of the electron. Taking into account the close similarity of the effects produced in hydrogen and oxygen, and the greater repulsive forces between the nuclei in the later case, it seems probable that the abnormal forces in the case of oxygen manifest themselves at about twice the distance observed in the case of hydrogen, *i. e.*, for distances less than 7×10^{-13} cm. Such a conclusion is to be anticipated on general grounds, for presumably the oxygen nucleus is more complex and has larger dimensions than that of helium.

In his preliminary experiments Marsden observed that the active source always gives rise to a number of scintillations on a zinc sulphide screen far beyond the range of the α-particle. I have always found these natural scintillations present at the sources of radiation employed. The swift atoms producing these scintillations are deflected in a magnetic field, and have about the same range and energy as the swift H atoms produced by the passage of α-particles through hydrogen. The number of these natural scintillations is usually small, and it is very difficult to decide definitely whether such atoms arise from the disintegration of the active matter or are due to the action of the α-particles on hydrogen occluded in the source.

These natural scintillations were studied by placing the source in a closed box exhausted of air about 3 cm. from an opening in the end covered by a sheet of silver of sufficient thickness to stop the α-rays completely. The zinc sulphide screen was fixed outside close to the silver plate. On introducing dried oxygen or carbon dioxide into the vessel, the number of scintillations fell off in amount corresponding with the stopping power of the column of gas. An unexpected effect was, however, noticed on introducing dried air from the room. Instead of diminishing, the number of scintillations was increased, and for an absorption equivalent to 19 cm. of air the number was about twice that observed when the air was exhausted. It was clear from the results that the α-particles in their passage through air gave rise to long-range scintillations which appeared of about the same brightness as H scintillations. This effect in air was traced to the presence of nitrogen, for it was shown in dry, chemically prepared nitrogen as well as in air. The number of scintillations was much too large to be accounted for by the presence of traces of hydrogen or water-vapor, for the effect observed was equivalent to the number of H atoms produced by the mixture of hydrogen at 6 cm. pressure with oxygen. The measurements were always made well outside the range of the recoil nitrogen and oxygen atoms, which we have seen are stopped by 9 cm. of air.

These swift atoms which arise from nitrogen have about the same brightness and range as the H atoms produced from hydrogen, and, presumably, are charged hydrogen atoms. Definite information on this point should be obtained by measuring the deflection of a pencil of these atoms in a magnetic and electric field. The experiments are, however, exceedingly difficult on account of the very small number of the scintillations to be expected under the experimental conditions. It should be mentioned that the evidence so far obtained is not sufficient to distinguish definitely whether these are H atoms or atoms of mass 2, 3, or 4, for the range and brightness of the latter would not be very different from those shown by the H atom.

It is difficult to avoid the conclusion that these long-range atoms arising from the collision of α-particles with nitrogen are not nitrogen atoms, but probably charged atoms of hydrogen or atoms of mass 2. If this be the case, we must conclude that the nitrogen atom is disintegrated under the intense forces developed in a close collision with swift α-particles, and that the atom liberated formed a constituent part of the nitrogen nucleus. It may be significant that from radio-active data we should expect the nitrogen nucleus of atomic mass 14 to consist of three helium nuclei of mass 4, and either two hydrogen nuclei or one nucleus of mass 2.

The effect produced in nitrogen would be

accounted for if the H nuclei were outriders of the main nucleus of mass 12. The close approach of the α-particle leads to the disruption of its bond with the central nucleus, and under favorable conditions the H atom would acquire a high velocity and be shot forward like a free hydrogen atom. Taking into account the great energy of the particle, the close collision of an α-particle with a light atom seems to be the most likely agency to promote its disruption. Considering the enormous intensity of the forces brought into play in such collisions, it is not so much a matter of remark that the nitrogen atom should suffer disintegration as that the α-particle itself escapes disruption. The results, as a whole, suggest that if α-particles or similar projectiles of still greater energy were available for experiment, we might expect to break down the nucleus structure of many of the lighter atoms.

Ernest Rutherford

SECOND AWARD OF THE ELLIOT MEDAL

The Elliot Medal is awarded annually by the National Academy of Sciences to the author of the leading publication of the year in zoology or paleontology. The first award was made for the year 1917 to Frank M. Chapman for his volume "The Distribution of Bird-Life in Columbia," published by The American Museum of Natural History. The second award for the year 1918 was to William Beebe, of the New York Zoological Society, on the completion of the first volume of his work on the "Pheasants."

In presenting Mr. Beebe to the Academy for the award, Professor Henry Fairfield Osborn made the following remarks:

Daniel Giraud Elliot, to whom the Academy is indebted for the Elliot Medal, was a leading ornithologist and mammalogist of the old school. He produced a series of splendid monographs on birds and mammals, and closed his scientific career with an exhaustive revision of the Primates. With the exception of a journey in Africa the greater part of his life was spent in museums, yet I believe if he were living he would not hesitate a moment to award the Elliot Medal for the Year 1918 to William Beebe on the completion of the first volume of his great work "A Monograph of the Pheasants."

This is a profound study of the living pheasants in their natural environment in various parts of eastern Asia. There are nineteen groups of these birds; eighteen were successfully hunted with the camera, with field-glasses, and when necessary for identification, with the shotgun. The journey occupied seventeen months, extended over twenty countries, and resulted in a rare abundance of material, both literary—concerning the life histories of birds—and pictorial, photographs and sketches. The journey extended over 52,000 miles; it ended in the great Museums of London, of Tring, of Paris, and of Berlin, for the purpose of studying the type collections. Thus the order of the work was from nature to the museum and to man, rather than from man and the museum to nature. It is this distinguished note of direct observation of natural processes, under natural conditions, which is needed to-day in biology to supplement the note of the laboratory and of experiment. Living birds and living mammals have as much to teach us in their natural surroundings as they taught Darwin and Wallace and we must endeavor to keep the eyes and minds of these great naturalists in our modes of vision.

The monograph covers the blood partridges, the tragopans, the impeyans, the gold and silver pheasants, the peacocks, the jungle fowl, and the history of the ancestry of our domestic fowls. It has important bearings on the Darwinian theories of protective coloration and of sexual selection, and on the De Vries theory of mutation. The full-grown male and female characters, the changes of plumage from chick to adult, the songs, courtships, battles, nests and eggs of nearly one hundred species are included and systematically described. The illustrations are by leading American and British artists. The haunts of the pheasants are shown in the author's photographs ranging from the slopes of the Himalayan snow-peaks, 16,000 feet

above the sea, to the tropical seashores of Java. Like Chapman's "Birds of Columbia," to which the Elliot Medal was awarded last year, this monograph puts the living bird, in its living environment, into the forefront.

It is for these reasons that the committee was unanimous, especially when its decision was confirmed without hesitation by Dr. J. A. Allen, the Nestor of American zoölogists. It is not the magnificence of this monograph, not the superb illustrations, not the delightfully written text, but the truly Darwinian spirit which animated the author and which sustained him through seven years of continuous research and his arduous labors in the preparation of this monograph. When completed, we believe that it will come nearer to depicting the actually living forms of this great group than any book which has ever been written on a single family of birds.

PROPOSED CONSTITUTION AND BY-LAWS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

This copy of the Constitution and By-laws is the one presented to the Committee on Policy by the subcommittee on revision. It was adopted by the committee and presented to the association at the Baltimore meeting. It will be presented for adoption at the St. Louis meeting.

Edward L. Nichols,
Chairman of the Committee on Policy

CONSTITUTION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Article 1. Objects

The objects of the Association are to promote intercourse among those who are cultivating science in different parts of America, to cooperate with other scientific societies and institutions, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness.

Article 2. Membership

Persons willing to cooperate in the work of the Association may be elected to be members by the Council. Members who are professionally engaged in scientific work or who have advanced science by research may be elected to be Fellows. The admission fee for members is five dollars; the annual dues are four dollars.[1] A member who pays at one time the sum of seventy-five dollars to the Association becomes a life member and is exempt from further dues. A person who gives one thousand dollars to the Association may be elected to be a sustaining member and is exempt from further dues.

Article 3. Officers

The officers of the Association shall be elected by ballot by the Council, and shall consist of a President, a Vice-president from each section, a Permanent Secretary, a General Secretary, a Treasurer and a Secretary of each section. The President and the Vice-presidents shall be elected for one year, the other officers for four years. The officers shall perform the usual duties of these offices under the direction of the Council.

Article 4. Council

The Council shall consist of the President, the Vice-presidents, the Permanent Secretary, the General Secretary, the Secretaries of the Sections, and the Treasurer, of one fellow elected by each affiliated society and one additional fellow from each affiliated society having more than one hundred members who are fellows of the Association, and of eight fellows, two elected annually by the Council for a term of four years. There shall be an Executive Committee of the Council, consisting of the President, the Permanent Secretary, the General Secretary, and eight members elected by the Council, two annually for a term of four years. The Council may appoint standing or temporary committees to make reports, to assist in the conduct of the work of the Association and to promote its objects.

Article 5. Sections

The Association shall be divided into the following Sections: A, *Mathematics;* B, *Physics;* C, *Chemistry;* D, *Astronomy;* E, *Geology and Geography;* F, *Zoological Sciences;* G, *Botanical Sciences;* H, *Anthropology and Archeology;* I, *Psychology and Philosophy;* J, *Social and Economic Sciences;* K, *Historical and Philological Sciences;* L, *Engineering;* M, *Medicine;* N, *Agriculture;* O,

[1] The Committee on Policy recommends that the annual dues be five dollars and the life membership fee one hundred dollars.

Manufactures and Commerce; P, *Education.* Members of the Association shall be members of that Section or of those Sections under which their work or their interests fall. Members of the Section shall nominate to the Council a Chairman, who becomes *ex officio* a Vice-president of the Association and whose term of office shall be one year, and a Secretary, whose term of office shall be four years. These officers, together with four fellows, one elected annually by the Section for a term of four years, and the representatives on the Council of affiliated societies in the same field shall form a Sectional Committee. This committee shall arrange the scientific programs of the meetings and may form sub-sections or hold joint meetings with other sections or other societies. It may appoint committees and shall in all ways promote the objects of the Association within its own field.

Article 6. Divisions and Branches

Regional Divisions and Local Branches of the Association may be formed by vote of the Council. Such Divisions and Branches may elect officers, hold meetings, appoint committees, enter into relations with other societies and promote within their fields the objects of the Association.

Article 7. Associated and Affiliated Societies

National and local scientific societies may, by vote of the Council, become associated with the Association. Those Associated Societies which the Council shall designate as Affiliated Societies shall be represented on the Council and on the Sectional Committees as provided in Articles 4 and 5.

Article 8. Meetings

The Association shall hold an annual meeting at such time and place as may be determined by the Council. Other meetings of the Association and of the Sections may be authorized by the Council. The Divisions and the Branches may hold annual and other meetings.

Article 9. Proceedings

The Proceedings of the Association and the list of officers and members shall be published in such manner as the Council may direct.

Article 10. Funds

The Permanent Secretary shall collect the annual dues and make expenditures as directed by the Council. The Treasurer shall deposit or invest the permanent funds of the Association, as provided for trust funds by the laws of the state of Massachusetts or the state of New York. Bequests and gifts will be administered in accordance with the provisions of the donors. The payments from sustaining and life members form part of the permanent fund, and the income (after the death of the member) shall be used for research, unless otherwise directed by unanimous vote of the Council or by a majority vote at two consecutive annual meetings.

Article 11. Alteration of the Constitution

This Constitution may be amended at a General Session by unanimous vote or by a majority vote at two consecutive annual meetings.

BY-LAWS AND RULES OF PROCEDURE

I

The Association is American, its field covering North, Central and South America. Inhabitants of any country are eligible to membership.

II

1. An incorporated scientific society or institution or a public or incorporated library may become a member by vote of the Council.
2. Associates on payment of four dollars may be admitted to the privileges of a meeting, except voting.
3. Foreign associates may be admitted without fee to the privileges of a meeting, except voting.
4. All members who are professionally engaged in scientific work, or who have advanced science by research, may be elected by the Council to be fellows on nomination or on their own application. This qualification is understood to have been met by members of affiliated societies having a research qualification.
5. The Council may exclude from the Association any one who has made improper use of his membership or whose membership is regarded as detrimental to the Association.

III

1. The Permanent Secretary, the General Secretary and Treasurer of the Association and the Secretaries of the Sections shall be elected at the larger convocation week meetings held once in four years beginning the last week of the year 1916. Vacancies in these offices shall be filled by the Council.
2. The President of the Association shall give an address at a general session of the Association at the annual meeting following that over which he presided.

3. The Vice-presidents shall hold seniority in the order of their continuous membership in the Association.

4. The Permanent Secretary shall attend to the business of the Association, the arrangements for the meetings and such other matters as the Council may designate. He may employ, with the approval of the Council, an Assistant Secretary. The salaries of the Secretaries shall be determined by the Council.

5. The General Secretary shall attend to matters connected with the organization of the Association, its relations to the affiliated societies and such other matters as the Council may designate. He shall receive such compensation as may be determined by the Council.

6. The Permanent Secretary, the General Secretary and the Treasurer shall present annually to the Council an account of the funds in their charge. These accounts shall be audited by an Auditor elected by the Council. There shall be a Finance Committee of three, elected by the Council, including the Treasurer, who shall give advice in regard to the investment of the funds of the Association. The Treasurer and the Permanent Secretary and General Secretary shall present a budget to the Council for the year following the annual meeting.

IV

1. There shall be a Committee on Grants, appointed by the President, with the advice of the Council, consisting of eight members, two appointed annually for a period of four years, which shall award for scientific research such part of the income from the permanent and special funds of the Association as may be appropriated for that purpose by the Council.

2. The following standing committees are authorized: Committee of One Hundred on Scientific Research; Committee of One Hundred on National Health; Committee on Delegates from Educational and Scientific Institutions; Committee on Expert Testimony; Committee on the Jane M. Smith Life Membership Fund.

3. A local committee shall be organized by the members resident in the place where a meeting of the Association is held. This committee may appoint an executive committee and other committees and shall make arrangements for the meeting, in cooperation with the Permanent Secretary and the other officers of the Association.

V

1. The Sectional Committees shall arrange for each annual meeting a program of general scientific interest, occupying usually one or two sessions. The Section shall not hold sessions for the reading of special papers when the affiliated society in the same field meets with the association.

2. No member shall take part in the organization or hold office in more than one section at any one meeting.

VI

1. A Pacific Division has been organized whose territory lies west of the "Rocky" Mountains. This Division and other Divisions that may be authorized by the Council have full control of their meetings, their affiliations with other scientific organizations, and of all movements to promote the advancement and diffusion of science in their territory. The Pacific Division shall be allowed for its expenses the entrance fees collected through its efforts and one dollar a year for each member in good standing.

2. Local Branches may be formed by members residing in the same locality. These branches shall be allowed for their expenses the entrance fees collected through their efforts and an amount for their expenses not to exceed fifty cents for each member in good standing.

VII

1. Affiliated societies having two representatives on the Council and on the Sectional Committees are:

2. Affiliated societies having one representative on the Council and on the Sectional Committees are:

3. Associated societies are:

VIII

1. A general session of the Association shall usually be held on the first evening of the meeting and at this session the address of the retiring president shall be given. Other general sessions may be arranged by the Council.

2. The Council shall ordinarily meet on the afternoon of the first day of the meeting. It may also meet at such other times as may be decided, and shall ordinarily hold a meeting in the spring at Washington.

3. The Sectional Committees shall ordinarily hold meetings on the morning of the first day of the annual meetings and may hold such other meetings as they may arrange.

4. The Executive Committee shall meet on the day preceding the annual meeting and at such other times during the meeting as it may decide. It shall ordinarily hold meetings in the spring and in the autumn.

IX

1. By arrangement with the publishers of Science this journal publishes the official notices and proceedings of the Association and is sent to all members in good standing, the sum of $2 being paid to the publishers of the journal for each member. Members may by request receive *The Scientific Monthly* in place of Science. This arrangement may be cancelled by the Council of the Association or by the publishers of the journal, after one year's notice has been given by either party.

X

1. The official year of the Association shall begin on October 1, and the dues of members are payable on that date. Only members who have paid their dues shall enjoy the privileges of the meetings and receive publications of the Association, but those not longer than two years in arrears for dues are retained on the membership list. Members dropped from membership for non-payment of dues may have their names reinstated by payment of arrearages or may be reelected with payment of the entrance fee. In the case of members of affiliated societies elected to membership in the American Association for the Advancement of Science within one year of their election to membership in the affiliated society, the entrance fee shall be remitted.

2. The Secretaries of the Association and of the Sections shall be allowed $30 in lieu of their traveling expenses to the annual meeting, or, if their expenses are less than that sum, the amount of their expenses.

3. Members of the Executive Committee shall be allowed $30 in lieu of their traveling expenses in attendance on meetings of the Committee, held apart from the meetings of the Association, or, if their expenses are less than that sum, the amount of their expenses.

XI

These By-Laws and Rules of Procedure may be amended by vote of the Council.

SCIENTIFIC EVENTS

THE SOUTHWESTERN GEOLOGICAL SOCIETY

On November 8, after several previous meetings, a number of the geologists of Dallas, Fort Worth, Austin, Shreveport, and other cities of the southwest organized an association, to be known as the Southwestern Geological Society. It is not the intention of the founders that the society shall be a competitor of either the Geological Society of America or the American Association of Petroleum Geologists, but that it shall be a regional organization comparable to the Cordilleran section of the Geological Society of America, the Geological Society of Washington, or other similar local organizations. It is also intended that it shall provide, through bi-monthly sectional meetings in each of the important cities of the southwest, frequent opportunities for the exchange of scientific data and views.

The promotion of fellowship and cooperation are the paramount aims, and publications, for the present, except of brief abstracts, will be a secondary consideration.

The membership will be drawn from those actively engaged in geology in the southwest, both academic and economic, and will include the professors of the state and other universities and members of the geological surveys, as well as those engaged in economic work.

The officers elected at the first meeting are as follows: President, Myron L. Fuller; vice-presidents, Wm. Kennedy and Wallace Pratt; secretary E. W. Shuler; treasures, R. B. Whitehead; council Robert T. Hill, H. P. Bybee, John A. Udden, W. E. Wrather and Chester A. Hamil.

Among the founder members were the following; Ellis W. Shuler, Myron L. Fuller, Robert T. Hill, F. W. Simonds, Wm. Kennedy, R. B. Whitehead, John A. Udden, F. A. Lahee, Wallace Pratt, F. L. Whitney, J. W. Beede, H. P. Bybee, E. B. Hopkins, C. A. Hamil, J. E. Brantly, V. V. Waite.

All geologists of good standing interested in the geology of the southwest are invited to send in their applications for membership to Dr. Ellis W. Shuler, secretary, Southern Methodist University, Dallas, Texas.

THE CHICAGO MEETING OF THE AMERICAN PHYSICAL SOCIETY

The 100th regular meeting of the American Physical Society will be held in the Ryerson Physical Laboratory of the University of Chicago, on Friday and Saturday, November 28 and 29, 1919. The occasion will be

marked by a symposium of papers of unusual importance on the electron-tube, presented upon invitation of the president of the society. There will also be the usual program of papers contributed by members in general. The Central Association of Science and Mathematics Teachers holds it annual meeting on the same dates, and arrangements are being made for the usual joint session.

The provisional program of special papers which will probably be given on Saturday morning, is as follows:

"Phenomena in pure-tungsten filament electron tubes," Irving Langmuir, The General Electric Company.

"Phenomena in oxide-coated filament tubes," H. B. Arnold, The Western Electric Company.

"The relations of the constants of an electron tube to its physical dimensions," L. A. Hazeltine, Stevens Institute of Technology.

"Theory of action of electron tubes as amplifiers," John M. Miller, Bureau of Standards.

"Theory of action of electron tubes as generators," John H. Morecroft, Columbia University.

"High power transmission sets," W. C. White, The General Electric Company.

"Telephone sets," O. B. Blackwell, American Telephone and Telegraph Company.

Members wishing to present papers at the Chicago meeting are requested to send abstracts ready for publication, to the secretary, before November 15. The secretary expects to send the program to all members before the meeting, but the delays in the mails are so great at present that members should not depend upon the program to determine their attendance.

The next following meeting of the society will be held in St. Louis in the week of December 29-January 3. Members are requested to submit abstracts of papers for this meeting at the earliest possible date, not waiting for further notice.

Dayton C. Miller,
Secretary

Case School of Applied Science,
Cleveland, Ohio

THE HISTORY OF SCIENCE AND THE AMERICAN HISTORICAL ASSOCIATION

The readers of Science may be interested to learn that at the coming annual meeting of the American Historical Association a conference will be devoted to the history of science. This is the first time that such a conference has been held, and it is earnestly hoped that many of those who are interested in this promising field may attend the session. whether they are members of the American Historical Association or not. The program, as thus far arranged, comprises papers on the History of Egyptian Medicine by Thomas Wingate Todd, professor of anatomy, Western Reserve University; on the History of Algebra by Louis C. Karpinski, professor of mathematics, University of Michigan; on Peter of Abano, a Medieval Scientist, by Lynn Thorndike, professor of history, Western Reserve University; and on The Problem of the History of Science in the College Curriculum, by Henry Crew, professor of physics, Northwestern University. The conference will take place in the Hollenden Hotel, Cleveland, Ohio, at 10 A.M., Wednesday morning, December 31.

Elbert J. Benton

THE SECTION OF ZOOLOGY OF THE AMERICAN ASSOCIATION

The Convocation Week meetings of Section F (Zoology) of The American Association for the Advancement of Science will be held in conjunction with those of the American Society of Zoologists at Washington University, St. Louis, Mo., on December 29. 30 and 31, 1919. As the officers of the American Society of Zoologists are responsible for the program under the rules of the American Association all titles and abstracts of papers should be sent to Professor W. C Allee, Lake Forest, Illinois. They should be in his hands before December 9. The address of the retiring vice-president of Section F, Professor William Patten, will be given at the annual dinner on Wednesday evening, December 31. The subject of the address will be "The message of the biologist." H. V. Neal,

Secretary of Section F

Tufts College, Mass.

THE DEFLECTION OF LIGHT BY GRAVITATION AND THE THEORY OF RELATIVITY

A joint meeting of the Royal Society and the Royal Astronomical Society was held on

November 6, for the discussion of observations made during the total solar eclipse of May 29 last. Sir Frank Dyson, the astronomer royal, opened the discussion, and was followed by Professor Eddington and other members of the eclipse expedition. Cablegrams to the daily papers report that the photographic plates show the deflection of the rays of light from the stars by the sun's gravitation that the Einstein theory of relativity requires. A similar attempt was made by the Crocker Expedition of the Lick Observatory in 1918, and the problem is described by Dr. W. W. Campbell, the director of the observatory, in SCIENCE for July 12, 1918. An article on relativity in physics by Professor Reinhard A. Wetzel, of the College of the City of New York, is printed in SCIENCE for October 3, 1918, and one by Professor William Marshall, of Purdue University, in *The Popular Science Monthly* for May, 1914. The article on the ether drift by Professor A. A. Michelson and Professor Edward W. Morley, which gave rise to the discussion, was printed in *The American Journal of Science* in 1887. Albert Einstein, then an employee in the patent office at Bern, first published his theory of relativity in the *Annalen der Physik* in 1905. Dr. Einstein later became professor in the Zurich Polytechnic School and was called to Berlin several years ago.

SCIENTIFIC NOTES AND NEWS

THE Nobel prize for physics for 1918 has been awarded to Professor Max Planck, of Berlin, and for 1919 to Professor Stark, of Greifswald. The prize for chemistry for 1918 has been awarded to Professor Fritz Haber, of Berlin.

THE National Academy of Sciences has voted to confer its Public Welfare medal on Mr. Herbert Hoover.

SURGEON-GENERAL WILLIAM C. BRAISTED, of the U. S. Navy Medical Corps, has been elected an honorary fellow of the Royal College of Surgeons of Edinburgh.

DR. M. C. TANQUARY, associate professor of entomology at the Kansas State Agricultural College, has resigned to accept the position of state entomologist of Texas, and chief of the division of entomology of the Texas Agricultural College. His resignation takes effect on February 1.

G. B. RICHARDSON has been placed in direct charge of the oil and gas section of the U. S. Geological Survey.

DR. G. DALLAS HANNA, who for eight years has been an assistant in the United States Bureau of Fisheries, has been appointed curator of invertebrate paleontology in the California Academy of Sciences. Dr. Hanna has for seven seasons been engaged in scientific work on the Pribilof Islands, Alaska, having taken the census of the fur seal herd for five consecutive years. He brings to the museum of the academy his collection of mollusks which numbers about 100,000 specimens.

SIR HENRY ALEXANDER MIERS, F.R.S., vice-chancellor of the University of Manchester, has been appointed a member of the advisory council to the committee of the privy council for scientific and industrial research.

AT the annual meeting of the Royal College of Physicians of Ireland, held on October 18, Dr. James Craig, professor of practise of medicine in Trinity College, Dublin, was elected president.

V. K. TING, director of the Geological Survey of China, is travelling in the United States.

PROFESSOR LYNDS JONES, of the department of zoology, of Oberlin College, conducted a party of students of ecology on a trip to the Pacific coast during the summer. The entire journey was made in automobiles—four Ford cars, a Franklin sedan, and a trailer. The route followed the Trans-continental, the Union Pacific and Northeastern to Omaha, thence to Yellowstone Park, spending several days in the park, up the Columbia River through eastern Oregon to Portland, then to Moclips, Washington, where camp was made and the party explored the coast and the neighboring islands. Except for occasional hospitality of friends along the way, every night was spent out of doors, and meals were

prepared over camp fire. Study was made while traveling of the animals, birds and plants, the nature of the country and the character of the soil, and lectures were given each day. The party left Oberlin on June 20 and returned on August 27 all in good health and reporting a most successful and enjoyable trip. For next summer a different trip is planned, through Colorado and Estes Park to California and the Yosemite.

It is stated in *Nature* that the Swedish Academy of Science has reported favorably on a request by Professor J. G. Andersson, formerly director of the Swedish Geological Survey, for a government grant of 90,000 kroner towards scientific researches and collections in China, where Dr. Andersson is now geological adviser to the Chinese government. It is hoped that the Swedish Riksmuseum will thus receive rich collections in paleontology, prehistory and zoology, but, to comply with conditions laid down by Professors Andersson and Witman, the fossil vertebrates will go to Upsala.

Dr. James R. Angell, on leave of absence as head of the department of psychology and dean of the faculties of the University of Chicago, now chairman of the National Research Council, recently visited the Carnegie Institute of Technology, Pittsburgh, and conferred with several members of the faculty who are particularly interested in the progress of research. In the afternoon, Dr. Angell addressed the faculty and graduate students of the division of applied psychology.

At the meeting of the Section on Medical History of the College of Physicians of Philadelphia, held on November 15, Lieutenant Colonel Fielding H. Garrison, M. C., U. S. Army, Washington, D. C., and Dr. Edward C. Streeter, Boston, presented a paper on "Sculpture and Paintings as Modes of Anatomical Expression."

The president, Professor James Ward, of Cambridge University, delivered the inaugural address before the Aristotelian Society on November 3 on the subject "In the beginning . . ." The congress which the society arranges annually will be held next year at Oxford in September, and the French Philosophical Society will take part.

A course of twelve Swiney lectures on "Geology and Mineral Resources of the British Possessions in Africa" will be given at the Imperial College of Science and Technology, London, by Dr. J. D. Falconer, on November 10 and later.

The tablets in memory of Lord Lister, executed for University College by Professor Harvard Thomas, were unveiled on November 11, by Sir George Makins, president of the Royal College of Surgeons, and Sir J. J. Thomson, president of the Royal Society. The Duke of Bedford, president of the Lister Memorial Committee, presided.

Dr. William G. Bissell, bacteriologist and sanitary expert, died on November 14, at the age of forty-nine years. He was director of the laboratories of the Buffalo Health Department for twenty-five years and past president of the New York State Sanitary Officers' Association. Since his graduation from the medical department of the University of Buffalo in 1892 he had practised there.

The National Academy of Medicine and the Surgical Society of Rio de Janeiro is compiling a catalogue of all medical publications that have appeared in Brazil within the past hundred years. This catalogue will be distributed at the celebration of the Centenary of Independence which is to be held in 1920. A Congress of Medicine will be held at the same time in Rio de Janeiro under the direction of Professor Fernando Magalhaes, president of the Medical and Surgical Association.

UNIVERSITY AND EDUCATIONAL NEWS

By the terms of the will of Dr. Henry K. Oliver, Harvard University receives funds for a department of hygiene.

The French minister of public instruction has introduced in parliament a bill covering an appropriation of 12,126,000 francs for the benefit of the universities, to be used in the

construction of new buildings, for repairs to old buildings, and for the installing of scientific equipment. The minister of public instruction also requests 900,000 francs to complete the construction work at the Institute of Applied Chemistry; 5,243,000 francs for the extension of the work of the departments of chemistry; 800,000 francs for the enlargement of the Radium Institute, and 1,500,000 francs for the construction of a laboratory of physical chemistry.

THE organization of the new department of hygiene and preventive medicine at Cornell University has been completed, the following appointments to the staff having been made: Dr. Haven Emerson, professor of hygiene and preventive medicine, and director of the department; Dr. James Stevenson Allen, assistant professor of hygiene and preventive medicine, and assistant director of the department; Dr. Frank C. Balderry. medical adviser; Drs. J. Ralph Harris, Lawrence B. Chenowith, Richard Kimpton, Claude E. Case and John A. Herring, assistant medical advisers for men and Drs. Margaret D. Baker and Katherine Porter, assistant medical advisers for women.

DR. ELI KENNERLY MARSHALL, JR., Washington, D. C., formerly associate professor of pharmacology in Johns Hopkins University, has been appointed head of the department of pharmacology at Washington University Medical School. Other appointments are A. W. L. Bray, associate in anatomy; Alfred C. Kolls, associate in pharmacology; Edgar Allen, instructor in anatomy and Edward A. Doisy, instructor in biological chemistry.

DR. EMIL GOETSCH, formerly resident surgeon of the Peter Bent Brigham Hospital, Roxbury, Massachusetts, has been appointed head of the surgical department of Long Island College, New York.

PROFESSOR HOWARD E. SIMPSON, associate professor of geology and physiography at the University of North Dakota, has been promoted to a professorship of geographic geology.

MR. B. MOUAT JONES, assistant professor of chemistry in the Imperial College of Science and Technology, London, has been elected to the chair of chemistry in the University College of Wales, Aberystwyth, in succession to Professor Alex. Findlay.

DISCUSSION AND CORRESPONDENCE

A HELIUM SERIES IN THE EXTREME ULTRA-VIOLET

IT has been shown that the helium series first discovered in a terrestrial source by Fowler can be represented by the formula

$$v = 109750\left(\frac{1}{\left(\frac{n_1}{2}\right)^2} - \frac{1}{\left(\frac{n_2}{2}\right)^2}\right);$$

where n_1 has the value of 3 or 4[1]

If n_1 be given the value 2, and n_2 the successive value 3, 4 and 5, lines result at wave-length 1640.1, 1214.9 and 1084.7. My previous investigations of the helium spectrum did not afford much evidence as to the existence of these lines;[2] a recent search, however, has been more successful. With a powerful disruptive discharge in helium, a sharp, fairly strong line appears at 1640.2; no trace of it is found in hydrogen under the same electrical condition and it does not occur in helium when the discharge circuit is free from capacity. Under the same violently disruptive condition the line at 1216, always present in helium and hydrogen, develops a satellite on its more refrangible side, this satellite is not well resolved, but its wave-length appears to be about 1215.1. The region that should be occupied by 1084.7 is obscured by a strong pair at 1085, probably due to an impurity.

Owing to the difficulties of vacuum spectroscopy it is perhaps unwise to claim that the evidence in this case is conclusive. I regard it as very probable, however, that two members of this series in helium have been found in the extreme ultra-violet.

THEODORE LYMAN

HARVARD UNIVERSITY,
October 25, 1919

[1] Evans, *Phil. Mag.*, 29, p. 284, 1915.
[2] *Astrophys. Jour.*, 43, p. 92, 1916.

DOUBLE USE OF THE TERM ACCELERATION

To the Editor of Science: Dr. Hering's letter in the issue of October 24 raises a question of scientific terminology of a kind not altogether unusual. He contends that the term "acceleration" is used in one sense by the engineer, namely, to signify the rate of change of speed; and indiscriminately, in two different senses by the physicist, one of these meanings coinciding with the engineering usage, and the other conflicting with it. This second use of the word is to denote the vector rate of change of another vector, the velocity. As I understand his letter, he proposes that the physicist abandon this second meaning in favor of the first.

Dr. Hering is an eminent engineer, and I leave it to other engineers to question, if they choose, his right to speak for them. I must protest however, against his version of the views of physicists. The term acceleration, in its strict sense, is now used by physicists only with the second of the two above meanings, and then applies, when used without any qualifying word, only to the motion of a point or particle. The word is sometimes used, in order to avoid circumlocutions, to denote merely the scalar magnitude of the vector. The need of a new word to express this second notion, in the manner in which we now customarily distinguish between velocity and speed, has long been felt. This somewhat loose usage is however quite different from the definition recommended by Dr. Hering, which would give it the meaning "tangential component of the acceleration." It would be rash to assert that the term is never used in this sense by physicists, for carelessness of language is hard to avoid, but few would be found to defend the usage.

Dr. Hering chooses as an illustration of the divergents of physicist and engineer:

> . . . the revolution of a fly-wheel at a constant speed, the rim of which to the physicist is being constantly accelerated while to the engineer there is no acceleration, as the speed is constant.
>
> The physicist argues, and quite correctly, that a moving body represents a vector quantity, as it has both speed and direction. The same external force applied to such a moving body will change either the speed or the direction, depending upon the relative directions of that force and of the moving body. But as force is defined as mass × acceleration, the physicist, apparently forgetting the difference between pure and applied mathematics, methodically divides this force by the mass and calls the quotient acceleration. It simplifies his mathematics.

I have quoted these remarkable sentences at length, because I should not dare to attempt any summarizing paraphrase. Assuming that the physicist is "arguing correctly" when he makes a "moving body represent a vector quantity," the offense seems to consist in "apparently forgetting the difference between pure and applied mathematics." What is this difference? It is that the "pure" mathematics is applicable to dynamical problems, whereas Dr. Hering's "applied" mathematics is not.

The case of the revolving fly-wheel offers no real difficulty either of treatment or of terminology. The "acceleration" of the fly-wheel as a whole is either a term without meaning, or applies to a translatory movement. Any point or particle of the wheel is accelerated toward the axis, from which we infer the existence of a force in this direction acting on the particle. Of the fly-wheel as a whole, we speak of the "angular acceleration," which is zero when the angular speed is constant and the direction of the axis invariable. From the vanishing of this vector we infer, not the absence of an external force, but the absence of an external torque or couple.

Take the case of a falling particle, describing a parabolic trajectory, and compare the two statements:

(*a*) The acceleration is g, vertically downward.

(*b*) The acceleration is $g \cos \theta$, where θ is the angle between the velocity and the downward vertical.

The second of these statements is in conformity with engineering usage, if I understand Dr. Hering correctly. The first statement describes the motion in such a way that if we know the velocity at any time we can

find the velocity at any subsequent time, by adding the vector gt vertically downward to the original vector velocity. The second statement assumes, so far as I can see, a knowledge of one of the quantities we need to calculate. I should very much like to see Dr. Hering's "applied" mathematics applied to this simple problem. So far as I can see, though the first statement simplifies the mathematics, the second abolishes it.

Scientific terminology is like a sharp knife used for the dissection of a problem, and unequaled for its intended purpose. It is an odd coincidence that the very number of SCIENCE which contains Dr. Hering's letter contains also an address by Dr. Gray of Edinburgh, in which the sharpness of this particular knife, the term acceleration in its strict sense, is specially noted. Dr. Hering's proposal is as if one should say, "I find your razor good for sharpening pencils, please shave with something else."

Surely the ends, neither of science nor engineering will be furthered by any such change as Dr. Hering recommends. The question is not one of simplified mathematics, but of clearness of thought.

C. M. SPARROW
ROUSS PHYSICAL LABORATORY,
UNIVERSITY OF VIRGINIA,

NOTES ON METEOROLOGY AND CLIMATOLOGY

AEROLOGICAL WORK—WINDS

AFTER the signing of the armistice had liberated much information that had been held as confidential, it became possible to assemble a group of papers on aerological work describing the pilot balloon methods used by the Weather Bureau, Signal Corps, and Navy for observing winds at various levels, and presenting the results of various lines of research.[1] The use of thousands of two-theodolite pilot balloon runs established an empirical formula for the ascensional rate of pilot balloons which tallied remarkably well with the formula derived from theoretical considerations. This formula is

$$V = 71(l/L^{2/3})^{5/8} = 71(l^3/L^2)^{.208},$$

in which V represents velocity, l the actual lifting power of the balloon ("free-lift"), *i. e.*, the weight it will support, and L the total lift (free-lift plus weight of balloon). Surprising as it is, pilot balloons ascend at a nearly constant rate, once they are above the more or less turbulent surface layer of air. Thus, single theodolite observations of angular altitude and azimuth of a balloon once a minute, when used in conjunction with the computed ascensional rate will yield reliable information as to the actual positions of the balloon, and, therefore, of the direction and velocities of the wind at all levels from the surface to the height at which it becomes lost to view. At the Aberdeen Proving Ground, temperatures for computing the densities of the air in the several altitude zones have been obtained by daily airplane ascents to a height of 10,000 feet. The score of pilot balloon stations in the United States east of the Rockies telegraph free-air wind data to the Weather Bureau in Washington twice daily, where they are used not only for aeronautical forecasting, but also as an auxiliary in making surface weather forecasts.

Meteorological kite flights are now being made at six stations daily (except when winds are light) for recording winds, relatively humidities, and temperatures aloft. The results are telegraphed to Washington daily, and later are published in *Monthly Weather Review Supplements*, where they become available for detailed investigation.[2]

The movements of dust, smoke and clouds are useful as well as balloons and kites for determining the movements of the free air. Dustfalls which occasionally occur in the northeastern United States have been traced

[1] *Mo. Weather Rev.*, April, 1919, Vol. 47, pp. 205–231. Separates of these are still available: apply to Chief, U. S. Weather Bureau, Washington, D. C.

[2] See, for instance, V. E. Jakl, "Some observations on temperatures and winds at moderate elevations above the ground," *Mo. Weather Rev.*, June, 1919, pp. 367–373. Separates of these are still available: apply to Chief, U. S. Weather Bureau, Washington, D. C.

back to the arid portions of the southern Great Plains.[3] Observations of forest-fire smoke also give reliable information of air movements over long distances, as in October, 1918, when Minnesota smoke was observed throughout the eastern half of the United States except along the gulf and south Atlantic coasts.[4] Observations on clouds may be complementary to those on pilot balloons, for the usefulness of pilot balloons decreases as the cloudiness increases. How cloud movements may be used in local weather forecasting has been discussed by A. H. Palmer for San Francisco, M. L. Fuller for Peoria, Ill., and H. H. Martin for Columbus, O.[5]

AIRPLANES AND THE WEATHER

An article on the "Effect of winds and other weather conditions on the flight of airplanes"[6] is a rather extensive, though by no means complete, compilation and discussion of aviators' meteorological experiences. To quote from the synopsis:

> The disturbances of the air due to daytime convection are one of the prime sources of bumpiness. Especially on hot summer days do strong, rapidly rising currents of air penetrate to great altitudes and, where encountered, jolt the airplane. Where the cooler air is descending, the effect is similar to that of falling into a "hole." The height to which the effects of surface roughness extend when the wind is blowing depends upon the speed of the surface wind and the height of the obstruction.
>
> In the free air, aviators' observations show how the layers of air flow over one another, the interface sometimes being marked by clouds and sometimes entirely invisible. At such levels are encountered billows or waves, and considerable difficulty is sometimes experienced in flying through such regions. Clouds, rain and fog all contribute to the discomfort and danger of flying.
>
> Perhaps the most interesting are the experiences in the thunderstorms and the up-and-down winds which accompany such storms. As the driving wedge of cold air at the surface advances ahead of the storm, the air into which the storm is moving is forced upward. The maximum turbulence is found in the region of the squall cloud, but the force of the rising air ahead of the storm is sufficient to carry up an airplane considerably, in spite of the efforts of the pilots to keep the nose of the plane down. The dangers from lightning and hail, are also quite as important as those from the capricious winds.

There is an annotated bibliography at the end. This article bound with two on ballooning and with reviews of Y. Henderson's "Physiology of the aviator," and H. Luckeish's "High lights of air travel," may be had on application to the Chief, U. S. Weather Bureau.

Charles F. Brooks

[3] See Winchell and Miller, *Mo. Weather Rev.*, November, 1918, Vol. 46, pp. 502–506.

[4] *Mo. Weather Rev.*, November, 1918, pp. 506–509.

[5] *Mo. Weather Rev.*, September, 1918, pp. 407–413; July, 1919, pp. 473–474, and August, 1919, pp. 567–570. A limited supply of separates is held by each of the authors named: address, "Weather Bureau Office" at cities named.

[6] *Mo. Weather Rev.*, August, 1919, pp. 523–532, 10 figs.

SPECIAL ARTICLES

A PRELIMINARY NOTE ON FOOT-ROT OF CEREALS IN THE NORTHWEST

During the first half of May, 1918, the Station Entomologist was called to Olympia, Wash., to consult with the farmers and county agent concerning an outbreak of aphis on wheat. He found that the aphids were not responsible for the whole trouble and submitted samples of wheat from the unthrifty fields to the station plant pathologist for diagnosis. Subsequently specimens showing the same disease were submitted from this and other localities in western Washington through the county agents of the respective counties.

Among the first lot of plants were some showing lesions at the base of the stem. These lesions were elliptical, light-centered, penetrating the leaf-sheath and the surface of the stem. Plants with these lesions and others with a general blackening of the lower nodes showed death of the roots at the first node, the plant attempting to make good this loss by putting out roots at the second node. In some plants two sets of roots had been successively killed and roots had been put out at the third

node. Affected plants were sickly in growth, yellowish in color and showed little or no stooling.

Later reports, especially from Cowlitz County, showed that the disease was responsible for uneven stand in the field with considerable lodging, the stems breaking over near the surface of the ground. As reported the disease showed no relation to type of soil or system of culture. The disease also appeared on oats and barley but in less severe form and showed more of a general blackening of the base of the stem and death of roots.

The disease was reported from Cowlitz, Snohomish and Thurston counties on wheat with the greatest severity in Thurston county, while it was reported from Cowlitz county as causing most injury to maturing grain. Reports of the disease on barley were received only from Pierce county. On oats the disease occurred in Clarke, Pierce and Snohomish counties. The wheat crop in certain localities of Cowlitz and Thurston counties suffered material injury while no data are at hand to show that the disease caused any material damage to the other cereals.

In 1902 Cordley[1] reported a foot-rot of cereals in Oregon but gave only a brief description of the disease and did not determine the causal organism. The disease he mentions is undoubtedly identical with the disease which appeared during 1918 in western Washington. No other occurrences of the disease in the united States are recorded. The disease is either a newcomer or has escaped general notice up to the present time.

A very careful microscopic study of the fungus found in the stem lesions was made in the attempt to determine the fungus. The mycelium was sterile, dark brown in color, with constrictions at the origin of side branches. The mycelium agreed fairly well with *Rhizoctonia solani* Kuhn., except in the diameter of the hyphæ which were only about half as large. In case of plants showing a very pronounced blackening at the base of the culm it was found that this was due to a very compact surface growth of dark brown hyphæ, approaching in some cases almost to a sclerotial formation.

No fruiting stage of the fungus has as yet been connected with the sterile stage on the base of the culms. Until this is done we can only compare symptoms, and vegetative characters of the fungus with published descriptions of foot-rot diseases of cereals. There seems to be a very close similarity between the disease as it occurs in Washington and the foot-rot of cereals caused by *Ophiobolus graminis* Sacc., as described by McAlpine[2] and others.

Ophiobolus graminis and other foot-rot fungi are known to produce an ascigerous stage on old stubble, so it seems probable that the fungus causing the foot-rot of cereals in western Washington will be found to have a perfect or ascigerous overwintering stage on the stubble of affected plants. There is also a possibility of the disease occurring on the native grasses. It is on these wild hosts that some of the foot-rot fungi are known to be carried through a crop rotation. It has not been possible to make a careful field study for the discovery of the ascigerous stage. In the limited work undertaken a species of *Pleospora* is the only perithecial form that has been found in the old wheat culms. It is not yet possible to say whether the disease in Washington is identical with any of similar European or Australian diseases.

Reports indicate that the disease is already rather widely distributed in western Washinging and Cordley's account of the disease would indicate that it may have been present for a considerable time. Time alone will determine whether the disease will become as serious as the foot-rot diseases of cereals in Europe and Australia have been.

B. F. Dana,
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Agricultural Exp. Station,
Pullman, Wash.

[1] Cordley, A. B., Ann. Rpt. Ore. Agr. Expt. Sta., 1912, pp. 66–67.

[2] McAlpine, D., "Take-All and White Heads in Wheat," Bul. Dept. Agr. of Victoria, 9: 1–120, 1904.

THE NEW HAVEN MEETING OF THE NATIONAL ACADEMY OF SCIENCES

The sessions of the autumn meeting of the academy were held in the Osborn Zoological Laboratory, Yale University, on November 10 and 11. The program of scientific papers was as follows:

MONDAY, NOVEMBER 10

Morning Session

Four cliff islands in the coral seas: W. M. Davis.

Some new theorems in the dynamics of a particle: Edward Kasner.

The relative physiological efficiency of spectral lights of equal radiant energy content (by invitation): Henry Laurens and Henry D. Hooker.

A study in synthetic paleontology (by invitation): Richard S. Lull.

The adjustment to the barometer of the hæmato-respiratory functions in man (by invitation): Yandell Henderson.

Development of connective tissue in the amphibian embryo (by invitation): George A. Baitsell.

Afternoon Session

A new method for determining the solar constant of radiation: C. G. Abbot.

A kinematic interpretation of electromagnetism (by invitation): Leigh Page.

Defects found in drafted men: Charles B. Davenport and Albert G. Love.

The effect of physical agents on the resistance of mice to cancer (by invitation): James B. Murphy.

Some restorations of extinct vertebrates. The great sponge colonies of the Devonian; their origin, rise and appearance: John M. Clarke.

On the mechanism of fever reduction by drugs (by invitation): Henry G. Barbour and J. B. Herrmann.

The Thompson effect from the point of view of dual electric conductivity: Edwin H. Hall.

TUESDAY, NOVEMBER 11

A statistical method for studying the radiations from radioactive substances and the X-rays (by invitation). Alois F. Kovarik.

Anatomical changes in the respiratory tract associated with acid insufflation (by invitation): M. C. Winternitz.

Experimental pneumonia in monkeys (by invitation): Francis G. Blake.

The extension of the ultra-violet spectrum. The effect upon an atom of the passage of an alpha ray through it: R. A. Millikan.

Leptospira icteroides and yellow fever (by invitation): Hideyo Noguchi.

Calculating ancestral influence in man (by invitation): H. H. Laughlin.

Calcium and magnesium metabolism in certain diseases (by invitation): Frank P. Underhill, James A. Honeij and L. Jean Bogert.

Reconstruction of the skeleton of the sauropod dinosaur Camarasaurus Cope (Morosaurus Marsh): Henry Fairfield Osborn and Charles Craig Mook.

Restoration of camarasaurus and life model (communicated by H. F. Osborn): William K. Gregory.

Plato's Atlantis in paleogeography (communicated by H. F. Osborn): William Diller Matthew.

Afternoon Session

Lethargic encephalitis and poliomyelitis: Simon Flexner.

The history of the coral reefs of Tutuila, Samoa. Biographical notice of Dr. Samuel Hubbard Scudder, 1837–1911 (read by title): A. G. Mayor.

Changes of land and ocean levels (by invitation): R. A. Daly.

On hyperplasia of nerve centers resulting from excessive loading (by invitation): Samuel Randall Detwiler.

Concentration of the water soluble vitamine of yeast: T. B. Osborne.

The manner of infection of the white pine by the blister rust, with demonstrations at the Connecticut Agricultural Experiment Station: (by invitation): G. P. Clinton.

Certain chemical properties of foods and their relation to nutrition, with demonstrations at the Connecticut Agricultural Experiment Station: T. B. Osborne and Lafayette B. Mendel.

Studies upon the life cycles of the bacteria (introduced by Raymond Pearl) (read by title): F. Lohnis.

Lower California and its natural resources (introduced by C. D. Walcott) (read by title): Edward W. Nelson.

A recalculation of the atomic weights (read by title): F. W. Clarke.

Biographical memoir of Richmond Mayo-Smith (read by title): Edwin R. A. Seligman.

Biographical memoir of Samuel Wendell Williston (read by title): R. S. Lull.

Biographical memoir of Charles R. Van Hise (read by title): Thomas Chowder Chamberlin.

WEDNESDAY, NOVEMBER 12

Morning Session

On the embryological basis of human mortality: RAYMOND PEARL.

Jupiter's five attendant planets (by invitation): E. W. BROWN.

Notes on human sex ratio (by invitation): C. C. LITTLE.

Sex intergrades and their peculiar inheritance (by invitation): A. M. BANTA.

The starting of a ship under constant power (by invitation): J. K. WHITTEMORE.

Endomixis in relation to selection in paramecia (by invitation): LORANDE LOSS WOODRUFF.

The activities of the ions of largely ionized substances: ARTHUR A. NOYES and DUNCAN MACINNES.

The basal metabolism of boys from one to thirteen years of age: FRANCIS G. BENEDICT.

AMERICAN MATHEMATICAL SOCIETY

THE two hundred and fifth regular meeting of the society was held at Columbia University on Saturday, October 25, 1919, extending through the usual morning and afternoon sessions. The attendance included forty-nine members.

Vice-president G. D. Birkhoff occupied the chair. The council announced the election of the following persons to membership in the society: Dr. C. C. Camp, University of Illinois; Professor Carl J. Coe, University of Michigan; Dr. Teresa Cohen, Johns Hopkins University; Mr. W. E. Heal, U. S. Bureau of Plant Industry; Dr. C. A. Nelson, University of Kansas; Mr. J. L. Walsh, Harvard University. Four applications for membership were received.

A list of nominations for officers for the coming year was adopted and ordered printed on the official ballot for the annual election. A committee was appointed to audit the treasurer's accounts for the current year. Propositions for establishing a board of custodians for the society's property and for issuing a new catalogue of the library were laid over for action at the annual meeting.

The following papers were read at this meeting:

Motion in a resisting medium: J. K. WHITTEMORE.

A countable collection of mutually exclusive closed point sets with connected sum: ANNA M. MULLIKEN.

New proofs of certain finiteness theorems in the theory of modular covariants: OLIVE C. HAZLETT.

On the convergence of certain classes of series of functions: R. D. CARMICHAEL.

Note on a transformation of series similar to the principle of inversion in the theory of numbers: R. D. CARMICHAEL.

Note on the theory of integral functions of the first class: R. D. CARMICHAEL.

Two linear integral equations with two parameters: ANNA J. PELL.

Note on stable periodic orbits: G. D. BIRKHOFF.

Some problems connected with submarine acoustics: O. D. KELLOGG.

Differential variations in ballistics, with applications to the qualitative properties of the trajectory: T. H. GRONWALL.

Standard density, temperature and pressure of the air aloft: A. A. BENNETT.

The probable error of a small number of rounds: A. A. BENNETT.

The physical bases of ballistic table computations: A. A. BENNETT.

The sign of the distance in analytic geometry: A. A. BENNETT.

Invariants of infinite groups in the plane: E. F. SIMONDS.

The motion of n bodies, under any forces, starting from rest: EDWARD KASNER.

The San Francisco Section met at the University of California on October 25. The annual meeting of the society will be held at Columbia University on December 30–31 and will be followed by that of the Mathematical Association of America on January 1–2. The Chicago and the Southwestern Sections will meet at St. Louis with the American Association for the Advancement of Science.

F. N. COLE,
Secretary

MEETING OF THE COMMITTEE OF POLICY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE committee on policy met at the residence of President Flexner, New York City, on Thursday, November 13, 1919, at 5 P.M. The meeting was called to order by the permanent secretary, who suggested that Mr. Flexner take the chair. Members of the committee present were: Messrs. Flexner, Humphreys, MacDougal, Cattell, Fairchild, Paton, Woodward, Noyes and Howard.

The minutes of the spring meeting were read and approved.

The permanent secretary made a statement re-

garding the error which had been made at the Baltimore meeting in electing three members of the committee in place of Messrs. Ward, Paton and Fairchild; whereas, three members should have been elected in place of Messrs. Cattell, Woodward and Noyes. On motion, Messrs. Cattell, Woodward and Noyes were requested to act as members of the committee, leaving the election of their successors and of the succeeding group until the meeting at St. Louis.

The permanent secretary presented a progress report with regard to plans for the St. Louis meeting and also plans under way for the increase in the membership of the association. He also presented a general statement regarding the condition of his current financial account.

Some discussion ensued, and Mr. Flexner was requested to deliver a popular lecture, complimentary to the citizens of St. Louis, on the evening of Tuesday, December 30.

A committee of three on the permanent secretaryship of the association was appointed, consisting of Messrs. Flexner, Noyes and Cattell.

On motion, it was moved and carried that the committee recommend to the council that the constitution be so amended as to make the annual dues be five dollars and the life membership commutation one hundred dollars. On motion, it was ordered that this amendment be published in a footnote to the new constitution to be published in SCIENCE.

On motion, it was decided to recommend to the council that in view of the increased cost of printing the price of SCIENCE per member be three dollars and further to recommend that the price of SCIENCE to non-members be fixed at six dollars.

On motion, the permanent secretary was directed to send out his bills for the year 1920 this month at the amount of five dollars. It was decided that in the campaign for new members now being carried on, members joining before January 1, 1920, pay the amount of eight dollars for combined entrance fee and dues.

After some discussion, it was decided that the committee approve of any effort to raise money for the new popular journal in the name of the association by the authorized committee of the National Research Council or its agents.

Mr. Cattell presented a progress report for the committee on state and local academies.

The report of the committee on grants was read by the permanent secretary.

Mr. Paton was requested, as chairman, to take up the work of the committee on delegates for the St. Louis meeting.

Dr. Charles E. Caspari was elected as secretary for Section C for the St. Louis meeting on nomination of Dr. Lovelace, chairman of the section.

The application of the American Academy of Medicine for affiliation was referred to a committee consisting of Messrs. Paton, Flexner and the permanent secretary for further report.

A letter from Mr. S. N. D. North, acting secretary of the Carnegie Endowment for International Peace, was read which suggested that the association endeavor to assist the work of the endowment by making an effort to bring about international cooperation between scientific organizations. A committee, consisting of Messrs. Angell, Humphreys and the permanent secretary, was appointed to confer with the Washington office of the endowment on this subject.

A letter from scientific men in El Paso, concerning a southwestern branch of the association was read and discussed. Mr. MacDougal stated that persons interested in this plan were to meet with the association in St. Louis for more intimate discussion of details.

A report of a call by Mr. Bourland, of the Southern Education Society, at the office of the permanent secretary was read. On motion, it was resolved that the committee looks with favor on the effort to increase the interest of the scientific men in the south and requests the permanent secretary to confer further with Mr. Bourland in regard to the plans suggested by the latter.

The committee adjourned at 9.45 P.M., to meet at St. Louis on Sunday, December 28, at the Hotel Statler, probably about dinner time.

L. O. HOWARD,
Permanent Secretary

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE HISTORICAL POINT OF VIEW IN THE TEACHING OF SCIENCE[1]

THE teachers of Missouri should take special interest in the history of science at the present time in view of the fact that the American Association for the Advancement of Science is expected to meet soon in this state and the question of forming a special section of this association for the purpose of considering topics in the history of science is to be raised during this meeting. Teachers of mathematics have an additional reason for taking an unusually keen interest in this subject just now in view of the appearance during the past summer of two very important books on the history of their subject.

One of these is entitled "History of the Theory of Numbers" and was prepared by Professor L. E. Dickson, of the University of Chicago, while the other bears the more general title "A History of Mathematics" and was prepared by Professor Florian Cajori, of the University of California, who holds the unique position of a regular professorship of the history of mathematics in a university. The former book is the first volume of the most complete history of number theory ever written and marks an epoch in American mathematical literature, while the latter is technically only a "revised and enlarged edition" of a book which appeared a quarter of a century ago under the same title, but the changes are so extensive that it too may be regarded as practically a new work.

The history of science should also be of peculiar interest to all educated people at the present time in view of the fact that this history is now being made very rapidly. The important rôle played by science in the recent world war can never be forgotten, especially since it points to a largely increased impor-

[1] Read before the Missouri State Teachers Association, November 7, 1919.

tance of science in a future great war in case there will be another. Perhaps the immediate development of applied sciences will be retarded by the feeling of security which a League of Nations may foster but pure science, which constitutes the foundation of applied science, is in need of calmer times for its most vigorous and systematic development. While war exhibits forcibly the need of science, times of peace create the atmosphere for scientific growth from the bottom, and the great rôle which science played in the recent war was doubtless largely due to the long period of comparative peace which preceded it.

One of the most striking events in the history of science has been the recent termination of former international scientific organizations and the steps towards the formation of new ones with a greatly increased amount of machinery. The whirl of organization machinery like the thunder of the cannon may serve to exhibit needs of science but it can scarcely be expected to create an atmosphere suited for the best scientific growth. If the scientific organizations are to become as complex as our American university organizations, so that those who secure the most prominent positions are administrative experts instead of eminent representatives of scholarship and research, there is good ground for misgivings at the present time.

A possible portent of great significance not only in the history of science but also in the history of education in general is the disturbed money condition which enables one to secure at present foreign books at an unusually low price. I recently paid a bill for some French books which were contained in a parcel post shipment made by a German firm shortly before we entered the war and were siezed in transit by the British government. I had to pay less than one fifth of the pre-war price for these books as a result of the small present relative value of the German mark.

If somewhat similar conditions prevail for a considerable time it seems likely that America will secure an unusually large amount of the literature now stored in Germany. As a result thereof our scholars may soon enjoy the best library facilities in the world and with this should come greater initiative especially along historical lines. Europeans have often made fun of our magnificent library buildings containing a comparatively small number of books. It is to be hoped that this number will soon be greatly increased as books are the most inexpensive educational agencies even in normal times and many of the older good books are likely to be sold at abnormally low prices for some time.

Notwithstanding these present special interests in the history of science, teachers should have a deeper interest in the permanent features of this history. Prominent among these features is the element of imperfection. Who is not interested when he first learns that Paciuolo the author of a very influential Italian work printed towards the end of the fifteenth century, tried to harmonize the facts that in Genesis the term "multiply" is used in the sense of increasing while if we multiply a proper fraction by a proper fraction we get a smaller product than either factor? Paciuolo concluded that increasing meant getting further away from unity; *e. g.*, $\frac{1}{2} \cdot \frac{1}{3} = \frac{1}{6}$, and $\frac{1}{6}$ is further from unity than either $\frac{1}{2}$ or $\frac{1}{3}$. In this way he thought he had explained the term multiply as regards proper fractions so as to be in accord with its use in the Bible.

Not an insignificant element of the educational value of the history of science is the opportunity which this history affords to inspire the student by the knowledge of having a clearer understanding of some scientific facts that the intellectual giants of earlier times had. If he is inclined to regard the rigorous geometrical demonstration of Euclid as superhuman he may be led to view the matter in a truer light by noting that Euclid was ignorant of the use of zero as a number as well as of the advantages of negative numbers. If he is dazzled by the deep mathematical insight of Newton he may realize his own mathematical advantages better when he learns that Newton knew nothing of the

brevity and elegance resulting from the use of determinants.

Fortunately the desire to excel is common to the young and old. I have often wondered to what extent the deep interest which women exhibit towards children, especially towards babies, is enhanced by the fact that in them they find human beings who do not pretend to know as much or more than they themselves do. At any rate the interest of young students can often be most easily aroused by guiding them so that they can experience that in at least some particulars they can make improvements on the work of others. The occasional discussion of possible improvements on the text-book or on articles in standard works of reference may serve a useful purpose if it is conducted in the right spirit. That some of the best works afford opportunities for such discussions may be illustrated by the article on "mathematical signs and symbols" in the new edition of the Encyclopedia Americana which is now almost completed and is noteworthy on account of its valuable mathematical articles.

The history of science is also useful because it instils optimism. That the history of science is in the main a history of progress needs scarcely to be emphasized in these days of rapid economic charges due to new scientific discoveries. The progress of science is in part reflected in the many new inventions and improvements contributing to our comfort in sickness and in health. The fact that these inventions and improvements are finally based on the work of such a large number of scientific investigators directs attention to the vast opportunities of rendering useful service in the field of science, and one of the most striking elements of the history of science is the fact that our rich scientific heritage is due to the work of millions for world betterment.

In the study of the history of science as well as in the study of science itself many students meet with the dilemma that what they would most like to know they can not know and what they can know they care little about. In both cases real progress is usually coupled with a willingness to work where progress seems possible. One of the most striking instances of this fact is furnished by the history of our common numerals. For centuries mathematical historians have been interested in the origin of these numerals and for a long time there was almost complete agreement that they were of Hindu origin and were transmitted to Europe by the Arabians. Hence the common name Hindo-Arabic numerals.

During the last dozen years various mathematical historians have re-investigated this question and have reached the conclusion that these numerals originated in Europe and not in Asia. One of the most active supporters of this new theory is G. R. Kaye, an Englishman residing in India, who wrote a book on "Indian Mathematics" (1915), and is inclined to give little credit to the Hindus for originality in mathematics. Instead of calling our common numerals "Hindu-Arabic" or "Babylonic-Hindu" it would be more in accord with our present state of knowledge to admit that they are of unknown origin, and if a student of the history of mathematics insists on knowing the origin of zero before taking up other historical questions it is likely that his knowledge of this history will remain zero.

As Cajori's history, to which we referred above, will probably be used widely as a text-book it seems desirable to refer here to a peculiarity which might otherwise cause perplexity. The author of this history speaks at various places about the origin of our common numerals and at all of these places save one he supports the theory that they are of Hindu origin. This single exception appears in a note on page 98 where he acknowledges our ignorance in regard to the origin of these numerals without, however, acknowledging explicitly his recent conversion to this view. It therefore happens that both those who support the theory of the Hindu origin of our common numerals and those who acknowledge agnosticism as regards their origin can find support of their views in different parts of the same book.

This singular fact seems to deserve public notice also because Cajori's work is the

largest and most modern general history of mathematics in our language and all English-speaking people who seek reliable information in regard to the development of this subject will naturally turn to it. The general reader will find here not only a history of the older mathematical developments but also a large amount of information about modern developments with due references to the contributions made by Americans.

Until recently America's share in the history of the advancement of mathematics was practically confined to the last fifty years, but recent study of the hieroglyphic writings of the Maya Indians of Central America and southern Mexico has established the fact that America has also a place in the history of ancient mathematics. In fact, the Maya used a kind of zero very early, possibly as early as the beginning of the Christian era. Their contributions are, however, very insignificant in comparison with those of the ancient Greeks, so that America has had only a small share in the advancement of mathematics except during the last half century.

Perhaps the most important feature of the history of science for teachers is the fact that in a broad way the history of the world portrays the history of the individual. Concepts which the world learned slowly are usually grasped slowly by the individual and the difficulties which the world experienced in the assimilation of these concepts are reflected in the individual student. Since the history of mathematics is so very old it is especially rich in suggestions as regards the learning process.

Another important feature of this history is that it tends to a clearer grasp of the most fundamental and fruitful facts of science. For instance, a great part of the development of mathematics during the nineteenth century centers in the ordinary complex numbers and in Taylor's expansion. It is interesting to note that for over fifty years from the time of the discovery of this expansion (1712) its importance was not generally recognized, and this fact furnishes another illustration of the difficulty involved in estimating the value of contemporary work in pure mathematics.

The history of science is interesting on account of its inexhaustible riches. Substantial progress in this field depends on the use of the intellectual telescope. Nothwithstanding the great importance of the use of the intellectual microscope which characterizes and ought to characterize most of our scientific work there is a charm for the student at times in using also an intellectual telescope in his scientific outlook. Like the distant sun warms and fructifies our earth so distant scientific facts stream into our present life and constitute the source of our present scientific activity. Just as we are interested in the sources of the rays of physical light that cheer us by day and by night so we should be interested in the sources of the rays of intellectual light shining through the scientific literature and illuminating our intellectual pathway.

Few may be interested in a proof of the fact that the point of inflexion of every curve whose equation is of the form

$$y = x^3 + ax^2 + bx + c$$

is a point of symmetry and hence the graph of a quadratic in one unknown has always line symmetry while that of a cubic has always point symmetry, but every one is likely to take an interest in the discussions of the ancient Greeks relating to whether a straight line can be equal to a curved one, as well as in the contention that Achilles could not overtake the tortoise since he must first reach the place from which the tortoise started, but by the time he reaches this place the tortoise has moved ahead. Such scientific ideas from the springtime of intellectual world life have a perennial interest, especially for those in the springtime of their own intellectual life.

The history of science best suited for the young student is that which relates to fundamental questions which are apt to perplex him and not that relating to the preservation of the obsolete from oblivion. The historic setting should constitute the sugar coating of the otherwise bitter scientific pills. The body of the pill should, however, be selected for its curative properties. It must be remembered

that many of us are intellectually sick because we have not properly assimilated fundamental truths and the function of the teacher is to cure such intellectual disease after a proper diagnosis as well as to provide wholesome food for the healthy mind. My advice to the Missouri teachers therefore is: Provide yourself with a considerable variety of pills sugar-coated with scientific history and use them somewhat sparingly like other medicine, but be prepared to use them both as a preventative and as a cure whenever the occasion presents itself.

G. A. Miller

University of Illinois

THE SINGING SANDS OF LAKE MICHIGAN

The dune region of Lake Michigan extends along its eastern shore from Gary at the southern extremity to Mackinac at the northern with comparatively few breaks or interruptions. Throughout this region the sands near the water's edge, in dry weather, emit a peculiar but definite and unmistakable sound when the foot of the pedestrain pushes through them in an abrasive way. This unusual sound from an unusual origin is a source of great delight to children and an inciter of the curiosity of their elders, who, however, rarely pursue the subject far enough to arrive at an explanation for it. The sound is produced not only by the leather-shod foot, but is emitted also if the bare foot or hand is struck through the grains or if a stick is trailed, boy-fashion, behind.[1]

The sound has been compared or the attempt has been made to relate it to that produced by the pedestrian walking through soft snow; to the crunching noise so frequently noticed when walking through snow after very cold weather or by the wheel of a vehicle on such snow; also to the sound emitted by hard, granular snow when one walks through it; but it is like none of these and has a distinctive character all its own.

In a preliminary way several observations should be recorded as to the bearing of location and conditions of various sorts on the singing sands. The sound is produced only when the sand is dry, and apparently the dryer the sand is, the louder the sound produced. In wet weather or when the sand is moderately moist, the sound is not produced. In summer and indeed in the hottest weather the sound seems to be loudest, other conditions being the same, but it can be clearly heard at all seasons of the year, including winter, whenever the sand is dry. As one walks away from the water's edge he may be astonished to find out that the sound-producing sand ceases rather abruptly about fifty to one hundred feet from the shore line. These limits may vary at different locations but on the whole they are substantially correct. Back and away from the shore line, in blowouts and on the sides and tops of the dunes, the sound is never produced. There is no observable difference between the sand located near the shore and that located farther back or that forming the dunes, and indeed the sand which is washed up by the waves is that which, blown by the wind, goes to form the dunes.

The upper beach limit of the singing sands

[1] (See Thoreau's "Journal," entry of September 22, 1858, in "Autumn.") "One mile southeast of the village of Manchester struck the beach of 'musical sand,' . . . . We found the same kind of sand on a similar but shorter beach on the east side of Eagle Head. We first perceived the sound when we scratched with an umbrella or the finger swiftly and forcibly through the sand; also still louder when we struck forcibly with our heels, 'scuffling' along. The wet or damp sand yielded no peculiar sound, nor did that which lay loose and deep next the bank, but only the more compact and dry. The sound was not at all musical, nor was it loud. . . . R———, *who had not heard it,* was about right when he said it was like that made by rubbing wet glass with your finger. I thought it as much like the sound made in waxing a table as anything. It was a squeaking sound, as of one particle rubbing on another. I should say it was merely the result of the friction of peculiarly formed and constituted particles. The surf was high and made a great noise, yet I could hear the sound made by my companion's heels two or three rods distant, and if it had been still, probably could have heard it five or six rods."

is practically identical with the upper wave limit, that is, the boundary reached by the waves during storms. This limit is marked roughly by the line of driftwood and the lower limit of vegetation. The singing sands are therefore all subjected to periodical contact with the water of the lake and are moistened and washed by that water.

These observations include, I think, all the obvious ones in connection with the singing sands. The most casual observer will remark with astonishment their very sharply defined upper limit. As one walks from the water's edge up the beach and crosses the upper wave limit, he notices a sudden cessation of sound as he passes the upper line of driftwood and the commencement of vegetation. Beyond this point he may proceed into a blowout of clear sand quite identical in appearance, macroscopic as well as microscopic, and of the same composition by ordinary methods of analysis and yet this sand fails entirely to produce the sound of the beach sand. His first conclusion would be that the proximity of the water and waves of the lake must have some relationship to the sound-producing grains.

I wish to apologize in advance for offering an hypothesis of this sound production unsupported by convincing evidence. What follows may, however, serve as a working basis for other investigators and may lead to a true explanation of the sound-production.

My hypothesis briefly stated is this. The sand grains on the lower beach and as far as the upper limit of the storm beach are bathed periodically by the waters of the lake which contain various salts including calcium and magnesium bicarbonates. This water dries on the grains of sand, coating the surfaces with an extremely thin film of salts including calcium and magnesium carbonates. This film is of such a nature as to create considerable friction when rubbed and thus when the grains are brought into contact with various surfaces a sound is emitted. One may compare the action of the film of dried salts on the sand grains with the action of rosin on the violin bow. The beach sand is, of course, the same sand which later goes to form the dunes when transported by the wind but during this transportation, due to the abrasive action of grain against grain, much of the salt film is rubbed off and carried on by the wind in the same manner that clay dust is, to be deposited in quiet places as on the forest floor beyond. After deposition in blowouts or on dunes, the grains are subjected from time to time to the leaching action of rain water and this completes the removal of calcium and magnesium carbonates (in the form of bicarbonates and of the other salts) so that the original sand grain surface is restored or, to speak metaphorically, the sands lose their singing voice. Such is the hypothesis.

A typical analysis of Lake Michigan water shows the following constituents:[2]

	Parts per 1,000,000
Total residue	144.8
Loss on ignition	17.6
Chlorine	4.2
Sodium Na	8.3
Ammonium (NH_4)	.05
Magnesium Mg	10.9
Calcium Ca	28.2
Silica Si	1.9
Nitrate NO_3	1.0
Chloride Cl	4.2
Sulphate SO_4	10.0

Some samples of Lake Michigan water show a higher content of solids than that given in the above analysis, the maximum being about 160 parts per million.

When the singing sand from the beach is compared with dune sand or blowout sand under the microscope no difference is perceptible. When subjected to screen tests, the beach sands show themselves to be of the same physical composition and texture. By chemical analysis, according to the usual methods of conducting mineral analyses, both show the same composition. The amount, therefore, of salts in the hypothetical film above referred to must be therefore within the limits of analytical error.

Experiments to prove or disprove the hypothesis readily suggest themselves. Some of

[2] Bull. No. 10, Illinois State Geological Survey, 1909, "The Mineral Content of Illinois Waters."

the singing sands could be transported from the beach and placed in a perforated vessel, box or barrel, on dune or in blowout and left to be subjected to the action of rain for a considerable period of time, or some of the singing sands could be subjected to a tumbling action by rotating as in a laboratory rotating tumbler. After this some sand could be subjected to the leaching action of distilled water saturated with CO_2. For a third experiment, some of the dune or blowout sand could be wetted several times with lake water and subjected to a drying action between the wettings. Suitable sound tests should, of course, be made at the proper times.

These experiments should be performed by some one residing by the lake shore either permanently or during the summer so that advantage could be taken of changing weather conditions and rainstorms.

W. D. RICHARDSON

SCIENTIFIC EVENTS

THE HOUSE OF JOSEPH PRIESTLEY

THE original house and laboratory of Dr. Joseph Priestley, the great chemist who discovered oxygen in 1774, and came twenty years later to America, which is located on the banks of the Susquehanna river, at Northumberland, Pa., was purchased recently by graduate students of the Pennsylvania State College, who plan to move it to the campus and make it a lasting memorial.

Upon learning that the Priestley homestead, which was built in 1794–1796, was to be put up at public auction, the Penn State chemists sent as their representative to the sale Dr. G. G. Pond, dean of the School of Natural Science at the college. He was successful in making the purchase, and the historic mansion will be preserved.

Architects from the college will at once make the necessary surveys preparatory to the work of moving the Priestley house to the campus at State College. The house is of frame, and painting has kept the woodwork in a remarkable state of preservation, so that it may be possible to rebuild the greater part of the structure from the present lumber. Immense pine timbers used in the framework are as good as new and the old-fashioned interior decorations—arched doorways, fireplaces and stairway—are in such condition that they can be removed and replaced with comparative ease.

While the purchase of the house has been made by Dr. Pond for the Penn State chemistry alumni, who are scattered to all parts of the country, funds for its removal and erection on the college campus will be supplied by an as yet unnamed donor. Actual work of removal will probably be started in the spring. Northumberland is about sixty miles from State College, at the intersection of the north and west branches of the Susquehanna.

The reconstruction on the college campus will be along the old architectural lines, but modernized and adapted to some suitable use by the school of Natural Science, according to present plans. The house is an old landmark in Northumberland county, and can be seen on the outskirts of the town from trains on the Pennsylvania Railroad passing Northumberland. It is a two-story structure, with capacious attic space. It is about 45×50 feet, with a projection at each end about 25 feet square. One of these was the kitchen and the other the workshop, or laboratory, in which Priestley pursued his scientific study and experiments.

CIVIL SERVICE EXAMINATIONS

THE United States Civil Service Commission announces the following examination:

On December 23 for meteorologist (men only). Vacancies in the Signal Service at large of the War Department throughout the United States, at salaries from $1,600 to $3,000, and in positions requiring similar qualifications, will be filled from this examination. The entrance salary will depend upon the qualifications of the appointee. The duties of appointees will consist of the making, computing and recording of meteorological observations in connection with the meteorological service of the U. S. Army; also the instruction of enlisted men in such work. Competitors will not be required to report for examination at any place, but will be rated on

the following subjects, which will have the relative weights indicated, on a scale of 100: (1) Education, 40; (2) Experience, 60. Competitors will be rated upon the sworn statements in their applications and upon corroborated evidence.

On December 10 for assistant observer, Weather Bureau, for unmarried men. Vacancies in offices of the Weather Bureau throughout the United States, and in positions requiring similar qualifications at $1,080 a year, or higher or lower salaries, will be filled from this examination.

Applications will be received until further notice for associate physicist qualified in physical metallurgy, for men only, at salaries ranging from $2,000 to $2,800 a year; and assistant physicist qualified in physical metallurgy, for both men and women, at salaries ranging from $1,400 to $1,800 a year, to fill vacancies in the Bureau of Standards, Department of Commerce, for duty in Washington, D. C., or elsewhere, and in positions requiring similar qualifications in other branches of the service.

For scientific assistant, for both men and women, on January 7 and 8. Vacancies in the Department of Agriculture, for duty in Washington, D. C., or in the field. The usual entrance salary for this position ranges from $1,320 to $1,620 a year, but persons showing in their examinations that they are unusually qualified are occasionally appointed at higher salaries, not to exceed $1,860 a year.

SALARIES AT YALE UNIVERSITY

THE Yale Corporation at its last meeting increased the normal salary scale for full professors doing full-time work of a satisfactory character (which has in the past been $4,000, $4,500 and $5,000) to $5,000, $6,000 and $7,000, with the understanding that $8,000 will be given in a very few cases to men of exceptional ability as teachers and productive scholars. It is believed that this action, which will be retroactive from July 1, 1919, places the average salary scale for professors at Yale University above that of any other university in America, although in two or three other institutions a very small group of men receive as much as $10,000. Some full professors with whom special arrangements have been made will continue at lower salaries, but a majority will receive at least $5,000 or $6,000 a year. The vote passed by the corporation is as follows:

Voted, to approve the recommendation of the Salaries Committee that the following should be the normal salary standard, to be departed from only in exceptional cases:

Professors, full time	$5,000–$8,000
Professors, part time	$3,000–$6,000
Assistant and associate professors..	$2,500–$4,500

The salaries of the deans of the different schools were placed at from $6,000 to $8,000, depending upon the amount of work and responsibility devolving upon each.

The corporation adopted the following as the main criteria for determining salary increases within the normal scale:

(*a*) Usefulness as a teacher.

(*b*) Productivity and standing in the world of science, letters or art.

(*c*) Public service, including service to the university.

(*d*) Executive responsibility and efficiency.

These criteria were decided upon and the individual salaries are being determined as a result of the following vote passed by the corporation at its previous meeting:

Voted, to authorize the president and the chairman of the committee on educational policy in consultation with the deans of the college, and scientific school, and the graduate school to prepare a list of salary increases to be voted on at the next meeting, together with the criteria to be adopted in assignments to salary grades, with the understanding that the deans of other schools will be consulted when the salaries of their professors are under consideration.

Full-time instructors and assistant professors in the undergraduate schools doing satisfactory work had their salaries raised last spring—the former from the old $1,000–$1,600 to the new $1,250–$2,000 scale; the latter from $2,000, $2,500 and $3,000 to a new scale $500 higher for each grade. Some further increases of assistant professors' salaries are now under consideration by the joint committee of the

corporation and deans named above. It is expected that all decisions will be reached and all full professors in the university, aside from members of the law and medical school faculties, whose salaries were decided upon last year, will be informed on December first with reference to their salary status, a special meeting having been called for November 29 when the salary list will be finally acted upon.

CRYSTALLOGRAPHICAL AND MINERALOGICAL SOCIETY OF AMERICA

FOR several years the formation of a Crystallographical and Mineralogical Society of America has been contemplated, but the final steps leading to organization were postponed until after the close of the war. Those most concerned in the undertaking have recently been canvassed, and it is now expected that the society will be definitely organized during the meetings of the Geological Society of America in Boston, December 29 and 31.

The purpose of the society is to promote interest in crystallography and mineralogy and allied sciences. Although crystallographers and mineralogists in European countries have long been organized, there has never been a national organization in America. At some of our larger universities mineralogy was one of the first sciences to be taught. Further, the growing application of mineralogy in the development of our vast mineral resources and the increasing use of mineralogical methods in allied sciences and in industry demand an ever-increasing number of technically trained men. There are therefore sufficient reasons why those actively engaged in these fields of science in America should be banded together.

In the organization of the society it is proposed to have two types of membership, such as fellows and members, or members and associate members. The first group would include persons who have published results of crystallographical and mineralogical research, while the second group would consist of persons engaged or interested in crystallographical and mineralogical work. It is planned to hold annual meetings for the reading of papers and the transaction of business, as is customary with national scientific societies. It is also hoped that the society will soon be able to support an independent publication, preferably a monthly journal, devoted entirely to the special field of the society. American crystallographers and mineralogists have long realized the need of such a journal in which their contributions could be published without necessary delays.

Annual fees of $3.00 to $5.00 are suggested. These annual fees are to include subscription to the journal of the society when established, which preliminary investigations indicate can be done in the near future.

All interested in the founding of this society are urged to attend the organization meeting to be held in Boston, at the Copley Square Hotel, Tuesday, December 30. Further, all prospective members regardless of whether or not they can attend the above meeting are requested to communicate with Edward H. Kraus, University of Michigan, Ann Arbor, Mich.

EDWARD H. KRAUS
(Michigan),
ALEXANDER N. PHILLIPS
(Princeton),
FRANK R. VAN HORN
(Case),
THOMAS L. WALKER
(Toronto),
EDGAR T. WHERRY
(U. S. Bureau of Chemistry),
HERBERT P. WHITLOCK
(American Museum of Natural History)

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE American Society of Zoologists will hold their annual meeting in St. Louis, December 29 to 31. The sessions on Monday, Tuesday and on Wednesday morning will be open for the presentation and discussion of papers. In agreement with the Botanical Society of America, the genetics papers will be placed on Tuesday morning. Tuesday afternoon will be given over to a joint session with the American Ecological Society in which half of the program will be given by each so-

ciety. An invitational program has been arranged for Wednesday afternoon as follows:

C. E. McClung: "The work of the National Research Council in relation to zoology."

J. T. Patterson: "Studies in Polyembryony."

C. H. Eigenmann: "Faunal areas on the Pacific slope of South America."

V. E. Shelford: "Physiological life histories of terrestrial animals."

The entire program is in conjunction with Section F of the American Association for the Advancement of Science. The address of Professor William Patten, of Dartmouth College, the retiring vice-president of Section F, will be given following a zoology dinner on Wednesday evening, December 31. The subject is: "The Message of the Biologist." Following the address, moving pictures taken on his recent Barbadoes-Antigua Expedition will be shown and explained by C. C. Nutting.

The Statler Hotel will be headquarters for the zoologists.

W. C. ALLEE,
Secretary-Treasurer

THE SECTION OF GEOLOGY OF THE AMERICAN ASSOCIATION

SECTION E—Geology and Geography—of the American Association for the Advancement of Science will hold its meetings at St. Louis, Mo., on Tuesday and Wednesday, December 30 and 31, with the possibility of an extra session on New Year's Day if enough papers are offered to make such a session desirable. The address of the retiring vice-president of Section E, Dr. David White, of the U. S. Geological Survey, will be upon the topic "Geology as it is taught in the United States." One joint session with the Association of American Geographers is being planned. The meetings of Section E will be presided over by Dr. Charles Kenneth Leith, of the University of Wisconsin. Titles of papers to be read before the Section should be in the hands of the secretary, Dr. Rollin T. Chamberlin, University of Chicago, before December 12.

THE SECRETARYSHIP OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AT a meeting of the committee on policy of the American Association for the Advancement of Science, held in New York City on November 13, Dr. L. O. Howard, who has served the association for twenty-two years as permanent secretary, stated that in view of the great enlargement in the work of the Bureau of Entomology, of which he is the chief, and the increasing responsibilities of the office of the permanent secretary of the association, he felt unable to hold much longer the two offices. He proposed that efforts be made to find an executive officer who would devote his entire time to the work of the association and the national organization of scientific work and scientific men for the promotion and the diffusion of science. There was consequently appointed a committee on the permanent secretaryship, consisting of Dr. Simon Flexner, president of the association, Professor A. A. Noyes, and Dr. J. McKeen Cattell.

It is believed that the secretaryship of the Smithsonian Institution, the presidency of the Carnegie Institution of Washington, the chairmanship of the National Research Council and the permanent secretaryship of the American Association for the Advancement of Science, are offices of coordinate importance, and that the secretary of the association, directly responsible to the scientific men of the country, should hold a position and exert an influence not inferior to that of any scientific man in the United States.

The filling of these offices is difficult, for it is undesirable to divert able scientific men from their work. But in the existing state of society there are needed those who will sacrifice their research work in order that others may have better opportunity, as in war men are ready to sacrifice their lives to enable others to live in freedom. It is possible that the secretary of the American Association by proper organization of scientific societies, scientific institutions and scientific men and by securing the interest and support of the public might increase by ten per cent. the productivity of science in America; only a Newton or a Darwin could do so much by his individual research.

The conduct of research under modern conditions requires executive ability, and men of

science are likely to possess this quality, as has been demonstrated by those who have been called upon for administrative work both in peace and in war. In filling executive positions of a scientific character, however, it may be desirable to consider those whose scientific work can be replaced, and those not engaged in research, but having a sympathetic interest in its promotion.

For the secretaryship of the American Association a man is needed who, either through his own work or through association with men of science, appreciates the supreme importance of scientific research for human welfare, both when its applications are obvious and when they are not. He must know that research can only be advanced by drawing to it the ablest men and by giving them the best opportunities, and that for recruits and for support the sympathetic interest of a wide public is essential. He should have the executive and administrative ability which keeps details in order and initiates new movements, and at the same time possess those personal qualities that compel others to share his convictions.

The committee on the permanent secretaryship of the American Association will be glad to receive suggestions concerning the conduct of this office and concerning men competent to fill it. The committee on policy has recommended an increase of the annual dues to $5, and with its 12,000 members the association should be able to support the secretary and his work as adequately as the office warrants.

SCIENTIFIC NOTES AND NEWS

DR. FRANK SCHLESINGER, director of the Allegheny Observatory of the University of Pittsburgh, has been elected director of the Yale Observatory.

MR. C. H. BIRDSEYE has been appointed chief topographic engineer of the U. S. Geological Survey, to succeed M. R. B. Marshall, who recently resigned as chief geographer. Mr. Birdseye was formerly chief of one of the divisions of topographic mapping and during the war served in France as lieutenant-colonel of the Coast Artillery.

COLONEL FREDERICK F. RUSSELL, of the Medical Corps of the army, has been appointed official representative of the medical department of the army in the government division of the National Research Council.

DR. FRANKLIN H. MARTIN, of Chicago, formerly colonel, M. C., U. S. Army, had conferred on him the Order of Commander of Saint Michael and Saint George by the Prince of Wales, in Washington, D. C., on November 14.

THE Boylston Medical Committee appointed by the president and fellows of Harvard College and consisting of Dr. William F. Whitney, chairman, Dr. Harold C. Ernst, Harvard Medical School, Boston, secretary, and Drs. William T. Porter, Edward H. Nichols, Reid Hunt, Henry A. Christian and John Warren, announces that at the annual meeting, held in Boston, in 1916, a prize of $300 was awarded for an essay entitled "Studies of the Streptococus of Smith," by Dr. Wilson G. Smillie, Cambridge, Mass.

R. C. ALLEN, Michigan state geologist, has resigned his office to become secretary of the Lake Superior Iron Ore Association, with offices at Cleveland.

MR. D. DALE CONDIT has resigned from the Geological Survey, and Mr. Ralph W. Howell is on a year's leave of absence, to accept positions as petroleum geologists with S. Pearson and Sons, Ltd. They sailed for England about the middle of October. Professor Olaf P. Jenkins, of the University of Arizona, who, as we recently announced, had planned to accept a position with this company has become geologist with the Sinclair Consolidated Oil Corporation, in New York City, and Mr. A. C. Veatch has been placed in charge of the exploration department of the same company.

THE council of the Ray Society has appointed Dr. W. T. Calman, of the Zoological Department, British Museum (Natural History), to be secretary in succession to the late Mr. John Hopkinson.

DR. WILLIAM H. RANKIN, for the last five years assistant professor of plant pathology in

the college of agriculture, Cornell University, has been appointed officer in charge of the Field Laboratory of Plant Pathology of the Canadian Department of Agriculture, with headquarters at St. Catherine's, Ontario, and has entered upon his work.

E. J. LAMBERT and A. J. Carlson, professors of the University of Minnesota, have completed an examination of the Mesabi and Vermilion range in the interest of the Minnesota Tax Commission.

WILSON POPENOE, agricultural explorer in the Bureau of Plant Industry, U. S. Department of Agriculture, sailed from California on November 12 for Central and South America, where he will search for economic plants worthy of introduction into the warmer portions of the United States. It is particularly planned to investigate the wild and cultivated avocados, and to obtain the most promising ones for trial in this country.

MR. ROBERT CUSHMAN MURPHY, of the Brooklyn Museum, is in Peru, where he is engaged in making investigations of the birds of the coastal islands. Moving pictures will be made of some of the colonies of pelicans, cormorants, and other sea birds of that region.

DR. HENRY KREPELKA, of Prague, in Czecho-Slovakia, has been appointed to a research fellowship in chemistry at Harvard and is engaged in the study and investigation of atomic weights under the guidance of Professor Theodore Richards. Dr. Krepelka has been serving as assistant to Professor Brauner, who is director of the chemical laboratory of the University of Prague.

AT the 823d meeting of the Philosophical Society of Washington on November 8, R. W. G. Wyckoff presented a paper on "The nature of the forces between atoms in solids" (illustrated), and H. L. Curtis, R. C. Duncan and H. H. Morse on "Methods of measuring ballistic phenomena on a battleship."

DR. E. V. McCOLLUM, professor of chemical hygiene in the school of hygiene and public health of the Johns Hopkins University, delivered an address before the Franklin Institute of Philadelphia on November 13, on "Nutrition and physical efficiency." On November 25 he spoke before the Institute of Medicine of Chicago on "The fundamental principles underlying modern nutrition investigations."

THE Bradshaw Lecture before the Royal College of Physicians was given on November 6, by Dr. A. P. Beddard, who spoke on chronic arthritis. The Fitzpatrick Lectures were given by Dr. Edgar G. Browne on November 11 and 13, the subject being "the origin and development of Arabian medicine."

UNIVERSITY AND EDUCATIONAL NEWS

OWING to the death of Mr. Edward M. Reed, which occurred on October 26, 1919, there is released for the general purposes of Yale Observatory one third of the estate of Edward M. Reed, the amount which should thus be added to Observatory funds during the year being estimated at $60,000 or more.

BY the will of Lawrence E. Sexton, a New York lawyer, Harvard University receives property valued at over $100,000.

DR. LOUIS C. KARPINSKI has been promoted from associate professor to professor of mathematics at the University of Michigan.

DR. EUGENE TAYLOR, formerly instructor who has been taking graduate studies at Harvard University, and Dr. E. P. Lane, of the Rice Institute, have been appointed assistant professors of mathematics at the University of Wisconsin.

DR A. K. LOBECK, instructor at Columbia University from 1916–18 and during the past year assistant to the chief cartographer, American Commission to Negotiate Peace, Paris, has been appointed assistant professor of geology at the University of Wisconsin.

DR. JOHN T. BUCHHOLZ, of the West Texas State Normal College, has been appointed professor of botany in the University of Arkansas.

DR. J. GRAHAM has been appointed professor of anatomy in the Anderson College of Medicine, Glasgow, in succession to the late Dr. A. M. Buchanan.

DISCUSSION AND CORRESPONDENCE

ATMOSPHERIC POLLUTION[1]

THE Advisory Committee on Atmospheric Pollution has published its fourth report summing up the observations in the year 1917–1918.

The full lists showing in detail the monthly deposit figures at various stations are not reproduced, inasmuch as these have been already published in the *Lancet;* but full returns from two stations, Newcastle and Malvern, are given; and these give the highest and lowest deposits.

Figures of total solids deposited monthly are given for all stations, 24 in number, the months being on a thirty-day basis.

In many instances the rainfall as measured at these stations did not agree with the amount obtained by the official Meteorological Office gauges but this is easily explained when it is remembered that the gauges of the committee are often on roofs and are thus elevated. The rainfall is given in millimeters, and it would be well if we in the United States would follow this example.

At a given London station the data for the half year, October to March, 1917–1918, were:

Rainfall 43 mm.; tar 0.14 metric ton per square kilometer; carbonaceous matter other than tar 2.18 tons; insoluble ash 3.50; soluble ash 4.15; or total solids 11.41 tons. Of the soluble matter there were 1.46 tons of sulphate, 0.63 tons of chlorine, and 0.05 of ammonia.

No relationship can be discovered between the deposit of insoluble matter and the amount of rainfall. With the soluble matter, however, it is different, and in general it may be said to vary directly as the rainfall. The relation may be roughly expressed by the formula, $S = 0.058\ R + 2.5$, where R is the rainfall in mm. and S the deposit of soluble matter in tons per square kilometer. It is not suggested that this expression can be used to find the soluble deposit when the rainfall is known but gives only the general nature of the relationship.

[1] Meteorological Office. Report on Observations 1917–18. Advisory Committee on Atmospheric Pollution, London, 1919.

The report also contains the results of analysis of the rainfall at Georgetown, British Guiana, the nearest land in the direction of the prevailing east-northeast trade winds being the shore of Morocco, distant 3,000 nautical miles. There can be little doubt that the solids contained in the rain waters collected are those normal to the rains of the trade winds, with perhaps some derived from the coastal sea-spray.

The average results over the two years 1916 and 1917 were as follows:

	Solids in Solution, mg./litre
Ca	7.95
Mg	3.44
K	2.77
Na	16.36
Al_2O_3	0.58
Fe_2O_3	1.97
SiO_2	0.20
Cl_2	33.93
SO_4	12.02
CO_3	9.78
NO_3	11.57
NH_4	0.12
	100.69

It is shown that 55 per cent. of the solids in solution in the rainfall are cyclic sea salts, while 45 per cent. must have been derived from atmospheric sources.

The report also contains an account of certain experiments made to determine the best method of measuring continuously the suspended impurity in the air. A. M.

CAROTINOIDS AS FAT-SOLUBLE VITAMINE

MY attention has been called to Steenbock's interesting observation, in SCIENCE of October 10, that yellow corn and the colored roots, such as carrots and sweet potatoes, are richer in fat-soluble vitamine than white corn and the pigmentless roots and tubers. A number of other instances are noted in which fat-soluble vitamine and carotinoid pigment occur simultaneously. The fact that these relations have led Steenbock to the provisional assumption that the fat-soluble vitamine is one of the carotinoid pigments has prompted me to call attention to a number of cases where this relation apparently breaks down.

Drummond[1] has recently tested the possibility of carotin being the fat-soluble vitamine by feeding both crude and crystalline preparations of the pigment to rats, although the question may be raised as to the logic of testing the relation to fat-soluble vitamine of a substance of which is not natural to the body of the animal upon which the test is performed. Carotin is not found in the body of the rat.

The writer[2] has recently reported the fact that it is possible to raise a flock of chickens from hatching to maturity on a diet free, or at most containing the merest traces, of carotinoids. Not only did the mature hens lay eggs whose yolks were free from carotinoids, but a second generation of carotinoid-free chicks were hatched from them. Only one of two possible conclusions can be drawn from this experiment. Either the fat-soluble vitamine and the yellow plant pigments are not related physiologically or the fat-soluble vitamine requirement of fowls differs from that of mammals. The diet which we used for the successful growth of the chickens contained an abundance of fat-soluble vitamine, however, in the form of carotinoid-free pork liver.

Another interesting case of negative relation between carotinoids and fat-soluble vitamine is seen in the fact that a number of species of animals, such as sheep, swine, dogs, cats, rats, rabbits, and guinea pigs are free from carotinoids in blood[3] and adipose tissues, and nerve cells.[4] The milk fat of the mammals of these species is also colorless. How is one to make the successful raising of young on carotinoid-free milk coincide with the assumption that fat-soluble vitamine is one of the yellow plant pigments?

Still another instance of negative relation between carotinoids and fat-soluble vitamine is seen in the case of certain vegetable oils, like cottonseed oil. Fresh cottonseed oil, after being purified from resinous material, has a beautiful golden yellow color and is rich[5] in carotinoids. It should also contain an abundance of fat-soluble vitamine to be in keeping with Steenbock's assumption. Apparently this is not the case since both bleached and unbleached cottonseed oil has been found to be free from vitamine.[6] The oil from yellow corn, similarly, should contain the vitamine, but the same investigation[6] has reported failure to obtain growth with diets containing the commercial unbleached corn oil.

It is thus possible to cite a number of instances where the probable relation between carotinoids and fat-soluble vitamine breaks down. No doubt others could be found. The writer regards the instances of a simultaneous occurrence of fat-soluble vitamine and plant carotinoids as fortuitous. The similarity of certain of the properties of the two kinds of material admittedly offers a working basis for the ultimate isolation of the fat-soluble vitamine, and research in this direction offers many fascinating possibilities. The relation between the vitamine and color in the case of corn may be a genetic one, in which case it should be possible to transfer the vitamine to white corn. Further attempts, however, to establish an identity of the vitamine with one of the carotinoid pigments is not likely to lead to profitable results.

Leroy S. Palmer
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1 J. C. Drummond, *Biochem. Jour.*, XIII., 81, 1919.

2 L. S. Palmer and H. L. Kempster, *Jour. Biol. Chem.*, XXXIX., 299, 1919.

3 L. S. Palmer, *Jour. Biol. Chem.*, XXVII., 27, 1916.

4 D. H. Dolley and Frances Guthrie, Science, N. S., L., 190, 1919.

5 L. S. Palmer and C. H. Eckles, Missouri Agr. Exp. Sta. Res. Bull. 10, 361, 1914.

6 E. V. McCollum, N. Simmonds and W. Petz, *Am. Jour. Physiol.*, 41, 361, 1916.

SCIENTIFIC ARTICLES

WOUND HEALING IN EXPERIMENTAL (CELLFIBRIN) TISSUE[1]

1. If we make a defect in the skin, processes of healing set in which in time lead to a closure of the wound. Primarily, the defect

1 From the Department of Comparative Pathology, Washington University School of Medicine, St. Louis and the Marine Biological Laboratory, Woods Hole, Mass.

calls forth an emigration of epidermal cells into the wound. Secondarily, cell proliferation by mitosis and a contraction of fibrous tissue takes place and these three processes contribute to the wound closure. Under certain conditions the intensity of cell migration depends upon the size of the wound; and the contraction of the wound, depending in all probability on the contraction of the fibrous tissue and the number of retracting fibers being greater in the larger than in the smaller wound, shows a certain quantitative relation to the size of the wound.

Essentially and disregarding complicating factors, the same stimulus leads to the migration of cells and to cell proliferation in wound healing.[2] To understand wound healing it is necessary to study experimentally the conditions which influence the migration of the cells into the wound. The important fact in wound healing is that in a tissue which was previously at rest, the making of a defect calls forth new activities in the cells adjoining the wound.

2. In earlier investigations we have shown that after the shedding of the blood of *Limulus* the amœbocytes agglutinate and thus produce a tissue-like organization which under certain experimental conditions bears a certain resemblance to epithelial, under others to connective tissue. This agglutination of cells is not accompanied by a transformation of fibrinogen into fibrin.[3] Subsequently we observed that an emigration of cells takes place from such tissue if pieces of this "cellfibrin" are put on a slide and kept under suitable conditions.[4]

We have recently resumed these experiments and have succeeded in working out methods which permit us within certain limits to imitate in an experimental tissue composed of agglutinated blood cells processes which are characteristic of normal tissues.

[2] A more detailed discussion of these conditions will be given in a forthcoming paper on wound healing in the *Journal of Medical Research*.

[3] Leo Loeb, *Biological Bulletin*, 1903, IV., 301; *Virchow's Archiv*, 1903, Vol. 173, 35.

[4] Leo Loeb, *Biochem. Zeitschrift*, 1909, XVI., 157.

3. In such experimental "cellfibrin" tissue the processes of wound healing and tissue grafting can be imitated, as far as the primary process in wound healing, namely the formation of layers of regenerating tissue through migration, is concerned. A defect in this artificial tissue, measuring about 6–8 square mm. can be closed in the course of two to three days, and a piece of tissue grafted into a defect can be seen to unite with the host tissue through regeneration taking place in the host as well as in the graft. We have every reason to believe that the essential factors underlying these healing processes in the skin of a mammal and in such experimental cellfibrin tissue are very similar. In both cases a tissue which has been in a resting condition is made to migrate into a wound under the influence of the wound stimulus.

4. In order to produce cellfibrin tissue, we collect in a stender dish a certain quantity of blood of a large *Limulus* under conditions which preserve the blood cells as much as possible. The latter form several layers on the bottom of the dish. The cells are glued to each other as well as to the bottom of the dish and thus form a compact even layer of tissue. With a scalpel we can make wounds of various sizes in this tissue and then readily follow with a low power of the microscope the different stages of wound healing. At the border of the wound we may recognize the outgrowth of the regenerated tissue even with the naked eye. In this defect we can transplant tissue of the same kind and follow the union between host and graft.

We may furthermore cut out a very small piece of tissue, place it on a cover glass, add a drop of blood serum or other fluid, and fix it with vaselin on a hollow slide, in the same way as in the case of other tissues growing in vitro. We can thus follow the radial outgrowth of the tissue. The pictures obtained correspond closely to those seen in the vitro culture of other tissues.

5. We have begun an analysis of the conditions determining wound healing in this

experimental cellfibrin tissue; we shall mention here a few of the results obtained so far.

(*a*) The influence of the temperature is very marked. The temperature coefficient seems to be such as might be expected, if wound healing depended upon chemical processes. While regeneration takes place steadily even in the ice chest at a temperature of from 6–10°, the outgrowth is much more rapid at a temperature of about 20°. Here however also secondary changes take place much more rapidly in the outgrowing cells.

(*b*) The depth of the layer of blood serum covering the wound or piece of cellfibrin does not seem to influence the rapidity of the healing process. This seems to indicate that the quantity of oxygen supplied is sufficient, even if a layer of serum about 10 mm. deep separates the tissue from the oxygen of the atmosphere. The amount of free oxygen was still further diminished in experiments made by Miss Clinton. Hydrogen passed through the blood serum for one hour previous to the introduction of the tissue into the serum. This was followed by a second period lasting fifteen minutes in which again hydrogen was carried through the serum. Even under these conditions outgrowth took place from pieces of cellfibrin previously placed on cover glasses.

(*c*) In a third set of experiments we compared the intensity of tissue movements in tissue growing in or against the direction of gravity. The tissue was held in a vertical position on the cover glass. We found that the tissues can grow out against the direction of gravity as well or almost as well as in the opposite direction. The average intensity of outgrowth is probably somewhat greater in the direction of gravity than in the opposite direction.

(*d*) If we observe tissue growing towards each other from different parts of a wound, or from two separate pieces of cellfibrin placed near each other, we find that the cells coming from opposite directions intermingle quite freely with each other. There is apparently no repellent action exerted by one sheet of tissue upon the movements of the others. It is evidently not the products of metabolism of certain cells which induce the cells to become active and to leave the position in which they had been at rest.

(*e*) By using our method it is possible to alter experimentally the base on which the tissue moves. Thus we can substitute a surface of paraffin, vaselin, coagulated egg or agar for glass or cellfibrin tissue. It is of considerable theoretical interest to determine the character of ameloid movements on substances like paraffin. We find that even on paraffin and vaselin an excellent outgrowth of tissue can take place, although the physical properties of these substances modify in some respects the behavior of the tissue cells. On coagulated egg and agar outgrowth takes place likewise but secondarily osmotic or chemical factors may come into play and injure the cells.

(*f*) We have begun the study of the effect of various inorganic substances, particularly of constituents of the blood and seawater on the movement of cellfibrin tissue in wound healing, and on ameboid movement in general. According to their effect on the tissue movements, we can arrange the various substances in the following order: (1) 2/3–1/2 *m* NaCl, (2) 2/3–1/2 *m* KCl, (3) 1/2 *m* $CaCl_2$, (4) *m*/3 Na_2 HPO4, (5) 5/8 *m* N H_4Cl, (6) *m*/3 Na H_2 P O4, (7) H_2O. NaCl is the least and N H_4Cl, Na H_2 P O.4 and H_2O are most injurious. In the latter solutions no distinct outgrowth takes place. How far certain variable factors as the amount of blood serum adherent to the tissue or bacterial infection may modify the results will have to be determined in further experiments.

Dilution of the solution within certain limits is not incompatible with outgrowth. Thus outgrowth can be readily obtained in a solution of 5 c.c. 5/8 *m* NaCl + 3 c.c. H_2O; addition of as much as 0.5 c.c. of a *m*/100 HCl or NaOH solution to 5 c.c. 5/8 *m* NaCl likewise permits frequently the outgrowth of tissue.

We wish to express our thanks to Mr. Julian P. Scott, who assisted us in these experiments.

Leo Loeb

THE AMERICAN CHEMICAL SOCIETY. IV

Symposium on annual patent renewal fees with the Division of Pharmaceutical Chemistry and Section of Dye Industry. E. J. PRINDLE, *chairman.* The symposium discussed various features of the proposal that a system of annual patent renewal fees shall be adopted for the United States. There were verbal or written discussions by: T. H. Anderson, L. H. Baekeland, J. M. Francis, Edwin A. Hill, A. D. Little, John Uri Lloyd, L. V. Redman, Mr. Stinchfield, Elihu Thomson, W. R. Whitney and others, including members of the Patent and Related Legislation Committee of the American Chemical Society, and members of the Patent Committee of the National Research Council. The chief ideas brought out in this discussion were found in the October, 1919, issue of the *Jour. Ind. and Eng. Chemistry.*

The use of crystallizers in cane sugar manufacture: CHARLES E. COATES.

The centrifugal method for the rapid determination of potash: L. S. CONVERSE. For control work, the common methods too long. Description of centrifugal method. Calibration of tubes, effect of speed and time on centrifuge effect of other salts, etc. Comparison of centrifuge and other methods. Usefulness and accuracy of method. It is impossible to obtain results accurate to 0.1 per cent. if the sample contains more than 12 per cent. potassium nitrate. Because of rapidity—20 minutes—it is useful for control work.

Comparison of methods for determining ammonium nitrate: J. T. GRISSOM. Need of rapid method for estimating ammonium nitrate. Comparison of nitrometer, kjeldahl and formaldehyde methods.

Effects of chlorides on nitrometer determinations of nitrates: M. T. SANDERS. It is not possible to determine nitrates in the presence of larger amounts of chlorides. Determinations with known quantities of chloride are given, results are discussed and reasons for abnormal results suggested. It is impossible to obtain results accurate to 0.1 per cent. if more than 15 to 17 per cent. sodium chloride is present in the dried sample.

The oxidation of methane. Quartz combustion apparatus: F. C. VILBRANDT and JAMES R. WITHROW.

Carbon black—its properties and uses: G. ST. J. PERROTT. An investigation of the carbon black industry has been undertaken by the United States Bureau of Mines as a result of economic issues brought up during the war. In the present process of manufacture carbon black is made by burning natural gas with a smoky flame against a metal surface and collecting the liberated carbon. The yield is from 2 per cent. to 7 per cent. of the total carbon in the gas. Other possible methods of making carbon black are considered. The uses of carbon black are discussed with particular attention to the ink and rubber industries. Testing methods are described and results of chemical and microscopic analyses of blacks making "long" and "short" inks are given. An explanation for the difference in working qualities of blacks made by different processes is proposed.

Adherent rust as an accelerator in the corrosion of iron and steel: W. D. RICHARDSON.

Some properties of commercial silicate of soda: J. G. VAIL.

The leaching of zinc chloride from treated wood: ERNEST BATEMAN. As the result of experimental work and analyses of ties which have seen several years' service, the following conclusions have been drawn: (1) In laboratory experiments as well as service tests the chlorine radical was drawn from the wood by leaching faster than the zinc radical. (2) The amount of each component leached can be calculated with fair accuracy from the diffusion constants of the hydrochloric acid and zinc chloride and the amount of each component present in the solution. (3) From the above it follows that the relative rate of leaching of any other salt from wood can be calculated if we know the amount injected and the diffusion constants of the salt. (4) The presence of comparatively large amounts of zinc in treated material does not insure that the wood is protected against decay unless a sufficient amount of acid be also shown to be present. (5) The basic chlorides of zinc seem to have little or no toxic effect.

Tensile strength of glue: G. HOPP. The paper describes a method for testing glue, by determining its exact tensile strength and elasticity. Hitherto all methods used were more or less arbitrary and entirely comparative. It was shown conclusively that the method is exact and opens a wide field for research and scientific standardization not only of methods of testing glue but also of selecting the right glue for a particular purpose.

A new illuminator for microscopes: A. SILVERMAN.

The stability of tetryl: C. L. Knowles. The following is an outline of the paper: Historical, general methods of preparation; general methods of purification; properties; most common impurities; causes of instability in tetryl; methods of testing stability of tetryl; action of sodium carbonate on tetryl; detection of sodium picrate in tetryl; effect of sodium picrate on stability of tetryl; conclusions; references.

The manufacture of trinitroxylene: John Marshall. The paper included the following: Discussion of preliminary experiments on the production of TNX; a study of the properties of a mixture of TNX and TNT when cast together; a discussion of the fraction of xylene best adapted to the production of TNX for explosive shell filling. The methd of nitrating; the nitration of pure meta-xylene; the composition of the mixed acid; the study of raw materials with particular reference to the rectification of solvent naphtha and the results obtained from the various ranges of the xylene fraction; the relative suitability of coke oven and water gas tar xylenes.

The preparation of hexanitro-diphenylamine and its use as a booster for shell charges: John Marshall. The following is an outline of the paper: Historical; the preparation of dinitrodiphenylamine; preparation of tetranitrodiphenylamine; nitration of tetranitrodiphenylamine to hexanitrodiphenylamine; preparation of hexanitrodiphenylamine by complete nitration of dinitrophenylamine with mixed acid; the neutralization of free acid in hexanitrodiphenylamine; the explosive properties of hexanitrodiphenylamine; sensitiveness of hexanitrodiphenylamine to detonation; sensitiveness to impact; sensitiveness to friction; rifle bullet test; explosive power of hexanitrodiphenylamine; effect as a booster; conclusions.

The composition of sponges: F. P. Dunnington. The common sponge, used in washing, grows in some warmer ocean waters and consists of a network of fiber-like material which is somewhat related in composition to silk fiber. Sponge has long been known to contain the somewhat rare element iodine, and occasionally bromine is mentioned as occurring with it; but little has been published about it that is definite. The author proposed to determine the exact amounts of iodine, bromine and chlorine in some sponges from different sources, and specimens from Florida, Cuba and Bahama Islands were analyzed. The amounts of these elements in these specimens differ greatly, but the average percentages for the four specimens examined are, viz.: iodine, .603; bromine, 1.307; chlorine, 1.06. When we consider the very small amount of bromine and the minute trace of iodine found in the water of the ocean, it is indeed remarkable that these animal organisms can thus select and collect them from the large portion of chlorine in the salt found there. We also note in this an explanation of the fact that these sponges can only grow in "open ocean water."

Quantitative determination of potassium as bitartrate: Sigmund Waldbott and Fred. W. Weissmann. This method was evolved in order to avoid the use of the expensive and difficultly accessible platinum chloride. It is applicable to mixtures of K- and Na-salts resulting from the regular analytical separation of other metals including Ca and Mg. Principle of procedure: To the *neutral* solution of K- and Na-salts add Na-bitartrate in slight excess, evaporate to dryness, displace the water-soluble salts by means of water saturated with cream of tartar at or slightly below the temperature of the laboratory, then judiciously displace the cream of tartar solution by the careful addition of alcohol. A straight calcium chloride tube containing a plug of cotton is useful in these operations. Finally heat to 100° C. for 1 hour in a current of air, cool and weigh. Fair uniformity of temperature is essential for the accuracy of the method.

The properties of pyroxylin plastics: R. P. Calvert and J. H. Clewell.

The extraction of potash salts from kelp charcoal: J. W. Turrentine, P. S. Shoaff and G. S. Spencer. The charcoal yielded by the destructive distillation of dried kelp is porous and readily yields its values, potassium and sodium chlorides and iodides when treated with hot water. In order to obtain a highly concentrated solution and at the same time efficient extraction, some counter-current system was found to be necessary. A solution of the problem was found in the adoption of a number of mechanical filter presses connected in series with each other and with leaching troughs interposed. The brine from one press is pumped into the leaching trough of the preceding one, while the press-cake from each press falls into the leaching trough of the succeeding one. Thus the brine is pumped up hill while the charcoal passes downward by gravity. The two streams passing in opposite directions counter-current extraction results. Filter presses of the revolving disk type and known as the American are employed. Filtration and washing are effected under vacuum and the press cake is broken loose by compressed air. The apparatus

shows high efficiency, is automatic and is regarded as eminently satisfactory.

"Kelpchar" a new decolorizing carbon prepared as a by-product in the extraction of potash from kelp: J. W. TURRENTINE, P. S. SHOAFF and G. O. SPENCER. Following the researches in the laboratories, respectively, of Dr. F. W. Zerban, of the Louisiana Sugar Experimental Station and of the Experimental Kelp Plant, of the United States Department of Agriculture, it was shown that a carbon of high activity could be produced in large quantities from kelp, depending on the method of retorting. One-stage retorting was efficacious, under certain conditons but did not yield a product of uniform or even dependable grade. Two-stage retorting, however, did yield a product of constant properties and made possible the large scale production. Accordingly this method was instituted pending the determination of the optimum conditions surrounding the one-stage operation. The product of the retorting or destructive distillation of kelp, a porous charcoal, is leached with hot water to remove potassium chloride and iodide and the residue, in the form of a press cake, is treated with the required amount of hot, dilute HCl to dissolve out soluble constituents and is then washed with water to neutrality. It is then dried and sacked for shipment. The tank system of extraction at present is in use. Acid proof construction is employed. The material is transferred from tank to tank in the sludge form by means of pumps, and spent acid and water are removed by filtering in situ over vacuum. The product compares favorably with Norit on molasses solution being equal in value and shows great usefulness when applied to materials of widely varying characteristics. It offers every promise ultimately of meeting the requirements of the chemical industry for a carbon of the highest grade.

CHARLES L. PARSONS,
Secretary

(*To be continued*)

THE AMERICAN ASTRONOMICAL SOCIETY

THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-third meeting of the society was held September 2 to 5, 1919, at the University of Michigan, Ann Arbor, where during the same week were also being held meetings of the Amercan Mathematical Society and of the Mathematical Association of America. Members of all three societies were housed at the Newberry Residence and at the Michigan Union, and the arrangements demonstrated the ideal condition of gatherings where members live close together for several days. There were about seventy members and guests present at the astronomical sessions.

In opening the first session, Acting President Schlesinger referred to the great loss which the society had suffered since the last meeting in the death of Professor Edward C. Pickering, who had been president of the society for thirteen years, and who had been the leading figure at its meetings throughout that time. The society had also lost Professor Charles L. Doolittle, who had acted as treasurer from the founding of the society in 1899 until he retired in 1912. The following resolution, which had been passed by the Council, was endorsed as representing the sentiment of the members of the society, and was ordered to be printed in the publications.

The council of the American Astronomical Society records with regret the death on February 3, 1919, of EDWARD CHARLES PICKERING, who had been president of the society since December 30, 1905. His success in introducing new methods into the observatory, particularly with regard to the determination of the brightness and the spectra of stars, his extraordinary ability in carrying out large projects, and the extent and diversity of his experience and knowledge, have given him a permanent place among the great names in the history of science. The society will keenly feel the loss of his presence at its meetings. The members of the society had every reason to regard him as a warm friend, and to them the sense of personal loss is very deep.

The visitors at Ann Arbor were hospitably entertained by the University of Michigan, and especially by Director and Mrs. Hussey at the Observatory. There was also opportunity to join forces with the mathematicians at a smoker and a dinner. There was one joint meeting of the three societies, with the following program.

"Mathematics and statistics." Retiring address of the president of the Mathematical Association of America. Professor E. V. Huntington, Harvard University.

"The work of the National Research Council with reference to mathematics and astronomy." Professor Ernest W. Brown, Yale University.

"Reports on the International Conference of Scientists at Brussels." Dr. Frank Schlesinger, Allegheny Observatory, Dr. L. A. Bauer, Carnegie Institution.

The time and place of the next meeting of the Astronomical Society was left to be determined by the executive committee.

Officers were elected for the ensuing year:

President—Frank Schlesinger.

Vice-presidents—George C. Comstock, Walter S. Adams.

Secretary—Joel Stebbins.
Treasurer—Benjamin Boss.
Councilors—Ernest W. Brown, Otto Klotz, Solon I. Bailey, W. J. Hussey, Henry Norris Russell, V. M. Slipher.

The program of papers was as follows:

Variations of type in the Cepheid variables l Carinae and η Aquilæ as shown by the general spectrum: SEBASTIAN ALBRECHT.
A systematic search for novæ at the Harvard Observatory: S. I. BAILEY.
On the change in the period of the variable star Bailey No. 33 in the cluster M5: E. E. BARNARD.
Remeasurement of Hall's star in the Pleiades: E. E. BARNARD.
Variable stars in M 11: E. E. BARNARD.
On the varnishing of astronomical negatives: E. E. BARNARD.
Some observations of the total solar eclipse on May 29, 1919, at Cape Palmas, Liberia: L. A. BAUER.
Hypersensitizing commercial panchromatic plates: S. M. BURKA. (Introduced by C. C. Kiess.)
Some recent developments in the study of SS Cygni: LEON CAMPBELL.
The spectra of variable stars of long period: ANNIE J. CANNON.
Atmospheric refraction near the horizon: GEORGE C. COMSTOCK.
Studies of class B spectra having hydrogen emission: R. H. CURTISS.
Fluctuations in the moon's longitude in relation to meteorological variations: RALPH E. DELURY.
Apparent relation between Chinese earthquakes and California tree growths, 0–1680 A.D.: RALPH E. DELURY.
Levels of the Great Lakes in relation to numbers of sun-spots: RALPH E. DELURY.
Simultaneous spectroscopic observations of the rate of rotation in north and south solar hemispheres: RALPH E. DELURY.
The periodograph and its application to variable star periods and other problems: A. E. DOUGLASS.
On the eclipsing variables RT Persei and U Cephei: R. S. DUGAN.
Preliminary results of a comparative test of the 100-inch and 60-inch telescopes of the Mount Wilson Observatory: GEORGE E. HALE.
Rates of the standard sidereal clocks at the U. S. Naval Observatory: J. C. HAMMOND AND C. B. WATTS.
Note on the spectrum of Nova Aquilæ No. 3: W. E. HARPER.
The orbit of the spectroscopic binary ι Delphini: W. E. HARPER.
The orbit of the spectroscopic binary Boss 4507: W. E. HARPER.
A desideratum in solving Kepler's problem: H. A. HOWE.
The red and infra-red arc spectra of eight elements: C. C. KIESS AND W. F. MEGGERS.
Color-index of planets: EDWARD S. KING.
Photographic observations of the Great Nebula in Orion: C. O. LAMPLAND.
Star tables good to the year 2000 for civil engineers and navigators: H. C. LORD.
Origin of the sun's heat: W. D. MACMILLAN.
False spectra produced by gratings: W. F. MEGGERS, C. C. KIESS AND F. M. WALTERS, JR.
Evidences of change in coronal structure during the eclipse of June 8, 1918: J. A. MILLER.
The masses of 32 visual binary stars: J. A. MILLER AND J. H. PITMAN.
Measures of double stars on photographs: CHARLES P. OLIVIER.
Shifting absorption at the heads of the brighter helium bands in the spectrum of γ Argus: C. D. PERRINE.
Methods of asteroid observation and reduction: GEORGE HENRY PETERS.
The great eruptive prominences of May 29 and July 15, 1919: EDISON PETTIT.
Studies in prominence characteristics: EDISON PETTIT.
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THE GENERAL BIOLOGY COURSE AND THE TEACHING OF ELEMENTARY BOTANY AND ZOOLOGY IN AMERICAN COLLEGES AND UNIVERSITIES[1]

THE general biology, or elementary biology, course originated with Huxley about fifty years ago and was introduced into this country by the physiologist, H. Newall Martin, one of Huxley's earlier students. In the introduction to Huxley and Martin's little text-book on Elementary Biology, Huxley states as his conviction "that the study of living bodies is really one discipline, which is divided into zoology and botany simply as a matter of convenience"; that "sound and thorough knowledge is only to be obtained by practical work in the laboratory"; and, further, that through the study of a series of selected animals and plants "a comprehensive, and yet not vague, conception of the phenomena of Life may be obtained, and a firm foundation upon which to build up special knowledge will be laid." A more recent text-book (Sedgwick and Wilson's "General Biology") states that general biology "deals with the broad, characteristic phenomena and laws of life as illustrated by the thorough comparative study of a series of plants and animals taken as representative types."

In the average general biology course the laboratory material is selected more or less indiscriminately from both the plant and the animal kingdoms, but with animal material greatly preponderant. The study of animals thus alternates with the study of plants: now a few animals and then a few plants. The aim of such a course is not so much to bring out the fundamental characteristics of plants as plants and of animals as animals, but rather to demonstrate that the two are merely different expressions of matter in the living

[1] Contribution from the Osborn Botanical Laboratory.

state and that the same broad underlying biological principles are applicable to both. Indeed there are some teachers who become so inspired with the idea of biology as the study of *living organisms* and with the prime importance of *underlying biological principles* that their students, pondering over the vague structures and intangible phenomena of a mysterious microscopic world, are led to lose sight completely of the fact that, after all, it is *plants* and *animals* they are dealing with—something they have been familiar with all their lives.

There are some botanists and zoologists to whom a general biology course means something quite different from what has just been described. It means two virtually independent, but consecutively arranged and more or less closely coordinated courses, the one in plant biology or elementary botany, and the other in animal biology or elementary zoology: these two, alike in their pedagogical objects but different in their material, being grouped together for educational or administrative purposes. But this is *not* the sort of a general biology course with which the present article deals. We are concerned rather with the first-mentioned type—the type which, in no small degree at any rate, has been responsible for the popular delusion that biology is the study of animals: that the words *biology* and *zoology* are synonymous.

Through the influence of Martin and his students general biology obtained a rather strong foothold in this country. It has been widely adopted by the high schools and was given a place in the curricula of many colleges and universities. Abroad, however, so far as the higher institutions of learning are concerned, it was not so favorably received. "In the universities of Britain, Germany and in most cases of France," according to a prominent American botanist, "a biology course has never been admitted or regarded as of sufficient thoroughness." And even in our own country, as will be pointed out in detail presently, the number of institutions of college grade which offer a course in general biology has diminished greatly in recent time. To use the picturesque phraseology of a noted contemporary botanist: general biology "is a kind of course introduced years ago by the Huxley and Martin book and discarded when botany became strong enough to stand on its own legs."

For a number of years it has been the conviction of the writer that a course in general biology of the type specified above ought not to be offered to elementary students, either as a cultural study or in preparation for more advanced work in botany or zoology. It has seemed particularly undesirable that in an institution having both a department of botany and a department of zoology such a course should be given by one department alone. With a view to ascertaining certain facts and securing a consensus of opinion regarding certain relevant problems, a questionnaire on this subject was recently submitted to 105 botanists, representing 67 colleges and universities, and to 65 zoologists, representing 49 similar institutions. Replies have been received from 86 botanists and 46 zoologists, representing altogether 66 institutions. The present article, in the main, is based on these replies and on a series of 19 letters relating to similar problems which was secured a number of years ago and courteously loaned to the writer by Professor Margaret C. Ferguson, of Wellesley College. To a very large extent the writer has acted merely in the capacity of editor or compiler in adapting and coordinating the various individual expressions of opinion set forth in these communications. Although quotation marks are seldom used, much of the subject matter in this paper has been quoted verbatim or with slight modification. For obvious reasons neither individuals nor institutions are referred to by name.

For present purposes American colleges and universities may be divided more or less naturally into two classes: *Class A*, those which maintain distinct departments of botany and zoology; and *Class B*, those in which both botany and zoology are under one head, the department of biology. Among the institutions investigated by the questionnaire, 47 of those heard from belong to class A, 19 to class B. Of those belonging to class A there

are only 6 which at the present time offer a course in general biology,[2] while among those of class B there are no less than 14 that give such a course. It is thus apparent that, among colleges, the giving of a general biology course is largely restricted, at the present day, to institutions which do not have distinct departments of botany and zoology. Of the institutions of this character investigated, 74 per cent. give such a course, and it is probable that this proportion would be considerably higher if the multitudinous smaller institutions not investigated were taken into account. Among the institutions which maintain distinct departments of botany and zoology, less than 13 per cent. of those investigated by questionnaire give such a course, and this proportion doubtless would be considerably lower if account were taken of various agricultural colleges and other institutions not included in the canvass. This disparity in itself is significant. But it is even more significant that, as was developed upon investigation, among the 41 institutions in class A which do not at the present time give a course in general biology there are no less than 21 which have given such a course in former years but have abandoned it. In other words, among the institutions included in this category, during the last twenty-five years *there has been a decrease of nearly 80 per cent. in the number which give a course in general biology.*

Some of the questions asked in the questionnaire, together with the expressions of opinion they called forth are as follows:

1. Is it your opinion that a course should be offered in general biology, complete in itself, so far as it goes, and necessarily overlapping more advanced courses in both botany and zoology: a course designed primarily for its educational value to the student who probably will pursue no further work along biological lines?

Replies.—Botanists: Class A, *No* (46:16); Class B, *Yes* (8:3). Zoologists: Class A, *Yes* (20:14); Class B, *Yes* (11:0).

2. If such a course is given, should it be made a prerequisite to more advanced courses in botany and zoology, or should it be treated as an entity in itself and be disregarded in arranging the regular courses of study in botany and zoology.

Replies.—Botanists: Class A, *an entity* (36:15); Class B, *an entity* (8:4). Zoologists: Class A, *an entity* (14:12); Class B, *a prerequisite* (8:1).

3. Is it your opinion that some sort of an elementary course in general biology is a desirable prerequisite to all courses in either botany or zoology? Should it be made an obligatory prerequisite?

Replies.—Botanists: Class A, *not obligatory* (51:9), and *not desirable* (47:13); Class B, *not obligatory* (8:4), and *not desirable* (7:5). Zoologists: Class A, *not obligatory* (21:10), and *not desirable* (19:14); Class B, *both obligatory* (8:1) and *desirable* (9:1).

4. Do you consider an elementary course in general biology to be superior, from the standpoint of the biological sciences in general, to two virtually independent but consecutively arranged courses: one in elementary botany, given by botanists; the other in elementary zoology, given by zoologists? Do you consider it inferior?

Replies.—Botanists: Class A, *biology inferior* (50:3); Class B, *biology inferior* (7:4). Zoologists: Class A, *biology inferior* (17:8); Class B, *biology superior* (8:0).

5. Assuming that an elementary course in general biology is to be given, should it be taught by zoologists alone? by botanists alone? or by both zoologists and botanists?

Replies.—Botanists (*a*) *by both botanists and zoologists*, 58; (*b*) *by one teacher, by a biologist, or by one trained in both botany and zoology*, 12; (*c*) *immaterial—depends on*

[2] In presenting these figures, no account has been taken of the subject-matter or the mode of presentation of these courses. It is important to note, however, that in 2 of the 6 institutions of Class A where general biology is still given, the course is virtually half botany, half zoology, being taught conjointly by botanists and zoologists. The same holds true in several of the 14 institutions of class B which are cited as giving general biology. In 3 of the 6 institutions in Class A, referred to above, general biology is placed in a class by itself, not being required as a prerequisite to courses in botany or zoology.

teacher, 3. Zoologists: (*a*), 25; (*b*), 12; (*c*), 6; (*d*), *by a zoologist*, 2.

Summarizing the opinions above stated, it is evident:

1. That the majority of botanists (49:24) are opposed to a course in general biology, while the majority of the zoologists (31:14) favor such a course.

2. That, if given, the majority of botanists (44:19) would treat it as an independent entity, while the majority of zoologists (20:15) would make it prerequisite to courses in botany and zoology.

3. That in the opinion of the majority of botanists a course in general biology does not constitute a desirable prerequisite (54:18) to courses in botany and zoology, and should not be made an obligatory prerequisite (59:13); while in the opinion of the majority of zoologists it is a desirable prerequisite (23:20), although it should not be made obligatory (22:18).

4. That the great majority of botanists (57:7) regard a course in general biology as inferior to two consecutively arranged but virtually independent courses, elementary botany and elementary zoology, while the zoologists are about evenly divided (inferior, 17:16) on this question.

5. That in the opinion of the majority both of botanists (58) and zoologists (25) a course in general biology should be taught by both botanists and zoologists rather than by either one or the other; while in the opinion of a minority (15 botanists, 20 zoologists) it should be given by one teacher.

Theoretically, a course in general biology such as the one here prescribed may seem desirable; practically it is not. This in effect is the opinion of many botanists and zoologists, both among those who voted in its favor and among those who voted against it. The truth of this assertion is substantiated by the relatively large number of institutions which in times past have organized such a course, only to abandon it. Whatever may be said in its favor, the fact remains that in the long run the general biology course has not proved satisfactory in at least the majority of those institutions having distinct departments of botany and zoology. On the whole, it appears that the advantages gained, if there are any, by attempting to dove-tail botanical and zoological material into one harmonious whole are more than outweighed by the disadvantages. The nature and seriousness of these disadvantages, as expressed by various college and university teachers, is indicated in the paragraphs which follow.

1. *An elementary course in general biology is altogether too dependent for its success on the personnel of its teaching staff.*

It is quite as important how a thing is taught the student as what is taught him. In the hands of a master, general biology, or any other subject, can not fail to be a source of profit and inspiration. But the type of course that leans too heavily for support on the personality of the teacher is destined to fail, sooner or later. Huxley's own course in elementary biology virtually died with him, for when he ended his teaching career at the Royal College of Science it was divided into two practically independent courses, a botanist being appointed to do the botanical teaching and a zoologist the zoological—an arrangement that has continued to the present day.

It is doubtless true that there are some zoologists who are capable of giving a better course in botany than are many botanists (and vice versa). But how many zoologists or botanists of this sort are there in charge of courses in general biology? Unquestionably there are occasional teachers of biology in our higher institutions of learning who are well equipped both on the botanical and the zoological side of biology, and who are impartially interested in both phases of life—men with a broad vision over both fields and competent both to organize and to conduct a course in general biology: in other words, true biologists. But in these days of specialization men of this type are so rare as to be almost extinct. The average biologist, so styled, is not a biologist at all in the true sense of the word. He reads the *Journal of Experimental Zoology* or the *Botanical Gazette*, but rarely both. He is a member of the Society of American Zoologists or of

the Botanical Society of America, but never of both. His research is in animal biology (or zoology) or in plant biology (or botany), one or the other. In short, he is either a zoologist or a botanist. To be sure, certain groups of botanists and zoologists find a common meeting ground in the American Society of Naturalists or in the Ecological Society of America. The geneticist, whether working with plants or animals, reads *Genetics* and the *American Naturalist;* the ecologist reads the *Journal of Ecology.* But the mutual interests which bind together various groups of zoologists and botanists are in very special fields, such as genetics, evolution, cytology and ecology. The fact remains that, while there are plenty of ardent zoologists and ardent botanists, there are few, if any, ardent biologists.

In charge of either zoologists or botanists how can a course in general biology help becoming one-sided? One phase is almost sure to be emphasized at the expense of the other, and the student can not avoid getting a distorted view of biology. Where taught by a zoologist general biology too often becomes zoology with a mere sprinkling of plants, and possibly vice versa. Even if he means to give fair and impartial treatment to both phases of biology, it is indeed a rare enthusiast who can avoid instilling his students with the greater importance of his own particular field of interests.

But there is still another objection to a general biology course being given either by a zoologist or by a botanist. There are altogether too many good zoologists, for example, whose knowledge of biology outside their own field is extremely limited. Only too often their familiarity with plants is little more than skin-deep. They may have sufficient information to enable them to work into a general biology course whatever of botany they deem essential, but beyond the covers of the text-book they have no real knowledge of the subject. Their thin veneer of botanical wisdom may well pass muster in a high school, but it does not take the more mature college student long to penetrate beneath the surface. It is an experience altogether too common that a student coming into botany from a course in general biology is so woefully lacking in his comprehension of plant life that it is necessary for him to repeat all over again the botanical studies he has already made. And what is more, such impressions as he has gained, quite as often as not, are inaccurate if not absolutely incorrect. The old adage is a good one: "Let the cobbler stick to his last."

If a course in general biology is to be given at all it should be conducted either by genuine biologists or else conjointly by both zoologists and botanists. A dual teaching force, part zoologists and part botanists, apparently has proved successful at some institutions where general biology is taught, but more often this arrangement seems to have proved a failure. A course given by two heads is liable to lack the necessary unity. Different points of view, interdepartmental jealousy, human nature: all these interfere with complete harmony. Such a course will naturally tend to resolve itself into two more or less distinct portions. Why not recognize this danger and, instead of attempting to splice together the subject matter of the two fields of biology, give two courses from the outset?

2. *Biology is a hybrid course.*

An elementary course in general biology interweaves a study of plants and animals in an impossible attempt to show to beginning students that the two sets of forms illustrate the same principles. The fact is that while botany and zoology are both biological subjects, botany is the study of one phase of life and the structures which it has built up, just as zoology is the study of another phase of life and the analogous but not homologous structures which it has built up. The elementary student needs to have emphasized, in studying these two sciences, the dissimilarities rather than the similarities. Each line of study has its most important problems of relationship, evolution and physiology connected in its series, and these can not be brought out as clearly nor with as much emphasis when the two are mixed up together. There may be some advantages, if one is con-

sidering only the lower organisms, in studying plants and animals together, but when it comes to the higher forms there is a distinct disadvantage in attempting to mix the two in one elementary course. For example, "what advantage is there in studying a fern by the side of a lobster, or an earthworm by the side of a moss, or a monkey with an oak tree—unless, indeed, you are going to consider problems of the athletics of the monkey in relation to the tree?"

There is no more justification for combining botany and zoology into one elementary course than there is for giving a combined elementary course in physics and chemistry. We may equally well have a general Greek-and-Latin course for elementary students which will introduce them at once to philology. The general biology course belongs in the same class with the general science course, which is universally conceded to be of too superficial value to merit a place in the curriculum of any institution above the grade of high school. It is but a step removed from the natural science course which figured in so many college curricula of a past generation.

3. *An elementary course in general biology lays too much stress on abstract principles and too little on concrete facts.*

"Sound and thorough knowledge is only to be obtained in the laboratory," writes Huxley. A firm basis of fundamental facts is absolutely prerequisite to a clear comprehension of underlying principles. This is just as true in the biological sciences as it is in chemistry or physics or mathematics. The student must actually work with plants as plants and with animals as animals and become thoroughly familiar with their structure, physiology and reproduction before he can appreciate broad generalizations. Make general biology, if anything, an advanced course in evolution or biological principles, to follow specific courses in botany and zoology: a summation, rather than an introduction. Teach the student to generalize on many particulars, not on a few. Train him first to be precise in his methods and accurate in his conclusions. Develop his powers of observation. In an elementary course in general biology the student is apt to become so enamoured of the grand general underlying principles that he has little use for details, with the result that he becomes loose and slipshod in his methods and utterly incapable of accurate, independent work. Let the student learn to be analytic before he attempts synthesis.

4. *An elementary course in general biology, as ordinarily presented, tends to give the student the impression that he has something he does not possess.*

Dealing in one short course, as too often it pretends to do, with all the large problems of life, general biology commonly aims to accomplish the impossible. Covering, as it seems to, the whole realm both of plant and animal life—morphology and physiology, evolution, cytology and genetics, not to mention bacteriology and hygiene—it leads the student to think he has a comprehensive knowledge of it all, when in fact he has only a superficial smattering of anything. Touching as it must only the high lights, it tends to muddle the student's mind and to leave him with little more than an uncoordinated jumble of facts.

5. *For students who plan to take further work in either botany or zoology, an introductory course in general biology is especially disadvantageous.*

It is primarily essential that such students, at the outset, should lay a firm foundation of fact upon which to base subsequent studies; that they should develop their powers of observation; that they should learn to work and think independently, to draw careful and accurate conclusions. It is disadvantageous that the introductory course should encroach upon the work of more advanced courses, for "when the student begins these more advanced courses he loses the advantage of entering entirely novel fields." And it is further disadvantageous, as so commonly is the case, that a student going on in botany should receive his introductory training in this phase of biology at the hands of a zoologist (and vice versa).

6. *In an institution having two distinct departments, a department of botany and a department of zoology, it is disadvantageous that*

one of these departments should give a course called general biology.

The disadvantages accruing from such an arrangement are patent to everyone and need not be detailed. The botanical department should give an elementary course in botany and the zoological department a similar course in zoology. If the zoologist wishes to use plant material to illustrate certain features (and vice versa), let him do so, but do not on that account let the course be labeled by the misnomer "general biology."

The general biology course owes its perpetuation, as it did its inception, primarily to the zoologists. The fact can not be overlooked that in institutions having distinct departments of botany and zoology, but where general biology is still taught, this course is in charge of zoologists, although in two of these institutions it is given in part by botanists. Further, in institutions having but one department, the department of biology, and where such a course is given, the department, as a rule, is predominantly zoological. And finally, it is more than a coincidence that nearly all of the many text-books in general biology now on the market, like their progenitor, have been written by zoologists (or else by high-school teachers). The Huxley and Martin text-book, to quote a former leader among American botanical teachers "was very useful, but its influence on botany was distinctly vicious. Wherever the book went, it put botany back as a mere 'Anhang' to zoology." It is books of this description that have led a well-known eastern botanist to define biology as "botany taught by a zoologist."

What, then, should be the nature of elementary courses in the biological sciences?

1. There should be two distinct courses: elementary botany or plant biology, taught by a botanist, and elementary zoology or animal biology, taught by a zoologist.

2. Each of these courses (or the two taken together; see below) should aim to achieve a two-fold end: it should serve as an introduction to more advanced courses, and it should also satisfy the requirements of the student for whom it will constitute the only biological course.

3. It is felt by many botanists and zoologists that special courses in the biological sciences should perhaps be arranged for the benefit of students who wish to take but one course in this field. Thus, nearly half of the botanists and zoologists who voted *in favor* of the general biology course, advocated that it be given, *not as a prerequisite* to advanced courses in botany and zoology, *but as an entity in itself*. Where the resources of an institution permit, "culture courses" in botany or zoology, or in botany and zoology, might well be offered in addition to the introductory courses in these subjects. Such courses would not be open to certain of the objections which have been urged against the general biology course. Indeed, while they might be planned along quite different lines from purely introductory courses, there is no reason why they should lay themselves open to any criticism whatever. There is always the danger, however, of attempting to be too comprehensive. Though perhaps to a lesser degree than when taken as a professional study, the value to the student of botany or zoology as a cultural study lies quite as much in methods acquired and in facts observed as it does in the information which is received. First and foremost the student should be taught to be careful in his technique, to be precise in his observations, to be thorough in his attention to details, to be keen in finding out things for himself, to be accurate in his conclusions. The content and scope of such courses must be determined by the individual teachers or departments concerned and the writer ventures no recommendations on this point.

In 50 of the 66 colleges and universities investigated by the questionnaire the elementary courses in botany and zoology are distinct from one another (this number includes 4 which in addition have a course in general biology). With reference to the arrangement of these courses, however, there are two groups. In one group, comprising 28 institutions, each course, elementary botany and elementary zoology, extends over a half year and the two, though vir-

tually distinct from one another, are so arranged that it is possible for the student to take them consecutively and practically as one continuous course within a year. In the other group, comprising 30 institutions, both the elementary botany course and the elementary zoology course extend through the entire year. In three institutions both of these schemes are in effect. While it is not the intention of the writer to express his personal views regarding the relative merits of these two schemes, the expressions of opinion elicited from botanists and zoologists at the various institutions where the respective plans are actually in operation, if not conclusive, are certainly suggestive.

In institutions where both elementary botany and elementary zoology are half-year courses, consecutively arranged, so that the student can take both within a year and practically as one continuous course, essentially the only objections offered are that in some places it is possible for the student to take one course, but not the other. Assuming, however, that a year's work is required (as of course it would be by either alternative arrangement) the consensus of opinion is as follows. This arrangement produces results satisfactory to both botanists and zoologists (botanists, 25:1; zoologists, 9:0). It possesses no serious disadvantages (botanists, 25:2; zoologists, 10:0). It is a satisfactory arrangement, both for the student who contemplates further work along biological lines (botanists, 25:1; zoologists, 10:0) and for the student who plans to go no further (botanists, 20:4; zoologists, 7.1).

In institutions where both elementary botany and elementary zoology are full-year courses, wholly independent of one another, the consensus of opinion is as follows. It produces results satisfactory to both botanists and zoologists (botanists, 27:3; zoologists, 16:6). According to the majority of botanists (20:8) it has no serious disadvantages; but the zoologists, by a small majority (12:9), are of the opposite opinion. According to the majority of both botanists (21:4) and zoologists (13:5) it is a satisfactory arrangement for students who plan further work in the biological sciences; but according to the majority of the both botanists (16:13) and zoologists (12:7) it does not constitute a satisfactory arrangement for the student who contemplates no further work along biological lines.

The arguments in favor of consecutive half-year courses in botany and zoology are self-evident. This arrangement gives students who will go no further some knowledge of the facts, principles and problems in both fields of biology, and at the same time it constitutes a satisfactory introduction to further work in either botany or zoology. Whether and to what extent it should be attempted to coordinate the two is a question concerning which opinions seem to vary, and in all probability this should be determined in large measure by local conditions. There is little question, however, that if properly coordinated these two courses will accomplish everything which can reasonably be expected of the general biology course, but with the objectionable features of that course eliminated. Advocates of the full-year elementary botany and zoology courses are of the opinion that a half year is not sufficient time for an elementary course in either botany or zoology; that botany and zoology, like chemistry and physics, should be treated as separate sciences; and that the student in either course obtains an introduction to the fundamental biological principles, methods, and facts. The chief objection to this scheme is obvious. The student who is going on with botany or zoology loses the advantage of an early introduction to both sciences, while the student who takes only one year of biological science loses entirely either one phase or the other.

But the object of this paper is *not* to recommend any specific arrangement of elementary courses in botany and zoology. It is *not* to settle questions as to the subject-matter of elementary courses in either subject. The primary purpose of this article is to urge, in the interest of the students, teachers, and departments concerned, and in the interest of the biological sciences themselves, that, in elementary courses, botany should be taught *as botany* and zoology *as zoology*. The general biol-

ogy course is "simply a survival of an early stage in the pedagogy of the subject and has no place in a modern educational scheme."

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STATE ACADEMIES OF SCIENCE

CERTAIN groups of people interested in the development and application of the sciences in many of the states of the union have established academies of sciences. Some of the academies have developed into institutions exerting considerable influence at the present time, others have flourished for a period and then gradually have declined in their force until now it has become a question whether they should disband or should reorganize. Others have struggled to develop interest for a considerable period in their communities but finally have ceased to exist.

During the past year data have been collected and an attempt has been made to determine the general status and activities of all the state academies in order that each one may know its own relative standing in regard to resources and activities.

CLASSIFICATION OF MEMBERS OF STATE ACADEMIES

State Academies	Botany	Chemistry	Geology	Mathematics	Medicine	Physics	Zoology	Unclassified	Total
Colorado......		20	75	11	5	15		20	146
Connecticut ..	4	4	12	2	12	4	7	128	172
Illinois.......	63	45	28	9	29	29	56	55	314
Indiana	51	24	16	10	22	23	55	30	231
Iowa	60	30	40	18	12	30	60	100	350
Kansas.......	20	30	10	10	12	12	10	79	173
Kentucky	13	24	12	9	4	13	12	9	96
Michigan	55	0	30	0	21	0	45	33	208
Nebraska	13	8	5	4	9	5	10	19	73
New Mexico..	3	3	3	5	0	3	2	6	25
North Carolina	13	13	4	4	1	6	15	24	80
Ohio	66	6	40	4	16	29	79	18	258
Tennessee.....	5	14	6	4	0	8	1	37	75
Utah	11	6	4	1	5	10	14	41	92
Total.......	377	227	285	91	148	187	366	599	2,293
Per cent....	16.4	9.8	12.4	3.9	6.4	8.1	15.9	26.1	

Questionnaires were sent to all state academies of science and the returned information has been tabulated. The classification of members was arbitrarily limited to eight groups and only aims to indicate the general field of interest of the members. Several academies did not furnish a classified list of their members. Each secretary was asked to state whether the interest in the affairs of the academy by its members was "lively" or "apathetic." Such statements, in some instances, should be taken with reservations because of the personal element or the period of the year in which it was given. Much of the data is self explanatory and needs no comments.

Among the various conclusions that may be drawn from the data the one that is especially evident is that only a small percentage of the scientific people of the country are members of the various state academies. The reason for this lack of interest and activity is explained by one secretary as being due to the fact "that the day has gone by when men interested in widely different special lines of research or activity can profitably meet for the common discussion of their interests."

At the present time nearly all specialists belong to a national society composed of members all of which are interested in the same special science. Such people derive more benefit from this society than they would from a local academy. In order to meet this situation many of the academies have attempted sectional meetings in which those interested in any particular science might convene. This has been successful in a few large academies but in the smaller ones it has failed.

Whatever may be said in regard to the weaknesses of the academies two points should be remembered. First, the academies provide at their general meetings opportunities for considerable social intercourse between people from different parts of their respective states. This social factor has a tendency to promote good fellowship between the various institutions of the state and also to encourage research in the smaller colleges and normal schools. Second, many of the academies are able from funds provided from

GENERAL DATA OF STATE ACADEMIES

Academies of Sciences.	Members	Annual Dues	Annual State Appropriation	Salary of Officers	Annual Pages of Publications	Interest
California	300±	$ 6.00	No data given			
Colorado	142	10.00	None	$600	110±	"Apathetic during war, but now interest is reviving."
Connecticut	172	5.00	From private funds, $1,530	None	450	"Lively interest in publications, but a decided lack of interest in the meetings."
Florida	88	1.00	None	None	None	"Dead"
Illinois	314	1.00	$1,000	None	345±	"More lively than apathetic"
Indiana	231	1.00	$700	None	475	"Good and getting better"
Iowa	350	1.00	Printing	None	550–600	"Lively"
Kansas	173	1.00	$1,300	$1,000	400	"Rather apathetic"
Kentucky	96	1.00	None	None	None	"Fairly lively"
Michigan	208	1.00	Printing	$75	300–400	"Interest reviving"
Nebraska	73	1.00	$150	None	75	"Lively interest at the annual meeting, but apathetic the remainder of year"
New Mexico	25	.50	None	None	None	
New York	624	10.00	From private funds, $2,538	$900	300–500	"Active"
North Carolina	80	1.00	None	None	125–150	"Very lively"
Ohio	258	1.50	From private funds, $250	None		Fair
Oregon						"Long time dead"
Tennessee	75	2.00	None	None	50±	"60 per cent. alive"
Texas	No data given excepting					"Apathetic"
Utah	92	1.00	None	None	244 (1908–1917)	"Rather apathetic"
Washington, D. C.	518	5.00	From private funds, $750	None	800	"Active"
Wisconsin	350	1.00	$1.500	$200	500	"About 50/50"
Wyoming						"Dead"
Philadelphia Acad. Nat. Sci.	458	10.00	From private funds, $36,000	$19.000	650	"Up to standard"
St. Louis	210	6.00	From private funds, $650	$900	200–300	"Majority apathetic"

state or private sources to publish articles of considerable scientific value which due to their extreme specialization, local or very general nature, would not be accepted by the current journals. If the academies have outlived their general usefulness they can still remain very influential in existing solely as publication centers for special articles.

The American Association for the Advancement of Science has recently proposed a plan in which it has invited the academies to affiliate with it. This is not only a very gracious act but one that may stimulate the academies to further and more important activities.

David D. Whitney,
President of the Nebraska Academy of Sciences, May 1918, to May, 1919

October 15, 1919

RESULTS OF THE TOTAL SOLAR ECLIPSE OF MAY 29 AND THE RELATIVITY THEORY[1]

The results obtained at the total solar eclipse of May 29 last were reported at a joint meeting of the Royal and the Royal Astronomical Societies, held on November 6. The stations occupied were Sobral, in North Brazil, and Principe Island. Two cameras were employed at Sobral, the 13-in. objective of the Greenwich astrographic equatorial, and a 4-in. lens, of 19-ft. focus, lent, together with an 8-in. cœlostat, by the Royal Irish Academy. It was realized before the expedition started that the cœlostat was scarcely suitable for observations of such extreme precision as were required to detect and measure the

[1] From *Nature*.

small shift in the places of the stars that might be produced by the sun's attraction. War conditions, however, made it impossible to construct a suitable equatorial mounting, though it is hoped that this may be done before the eclipse of 1922.

The results, to some extent, but, fortunately, not entirely, justified these apprehensions. The eclipse plates taken with the 13-in. (stopped down to 8 in.) are out of focus. Since the focus was good on photographs taken at night a few hours earlier, and also on the check plates taken before sunrise in July, the explanation appears to be a change of figure of the cœlostat mirror, due to the heat of the sun. These plates were compared with the July check plates by using a duplex micrometer. They show an undoubted gravitational shift, the amount at the sun's limb being 0.93″ or 0.99″, according to two different methods of treatment. The probable error, as estimated by the individual discordances, is about 0.3″, but there is reason to suspect systematic error, owing to the very different character of the star-images on the eclipse and check plates. This instrument supports the Newtonian shift, the amount of which is 0.87″ at the limb. There is one mode of treatment by which the result comes out in better accord with those of the other instruments. Making the assumption that the bad focus did not alter the scale, and deducing this from the July plates, the value of the shift becomes 1.52″.

The results with the 4-in. lens are much more satisfactory. The star-images are well defined, and their character is the same on the eclipse and check plates. As the duplex micrometer would not fit these plates, a key-plate, on which the film was placed away from the lens, was taken in July, and all the plates in turn were placed in contact with this plate and compared with it. The resulting shift at the limb is 1.98″, with a probable error of 0.12″. The values from the separate stars are in good accord, and they support the fact of the shift varying inversely as the distance from the sun's center; they are thus unfavorable to its being due to refraction, as was suggested by Professor Newall at the meeting. Moreover, Professor Lindemann pointed out that the comets of 1880 and 1882 had traversed this region without giving the slightest evidence of having encountered resistance; as their speed was about 300 miles per second, a vivid idea is given of the extreme tenuity of any medium that they encountered.

The Principe expedition was less fortunate in the matter of weather, but a few plates showed five stars. Since no check plates of the eclipse field could be taken there, another field near Arcturus was photographed, and both it and the eclipse plates were compared with plates of the same fields taken at Oxford with the same object-glass. It was, moreover, necessary to assume that the scale of the eclipse plates was the same as that of the check plate. This is justified by the fact that the diurnal variation of temperature in Principe is only some 4° F., and that there had been no bright sunshine on the mirror before totality. The measures indicate a shift at the limb of 1.60″, with a probable error of 0.3″.

It will be seen that the mean of this result and that with the 4-in. at Sobral agrees very closely with Einstein's predicted value 1.75″. It was generally acknowledged at the meeting that this agreement, combined with the explanation of the motion of the perihelion of Mercury, went far to establish his theory as an objective reality. Sir J. J. Thomson, who presided, spoke of the verification as epoch-making; he suggested that it would probably have a bearing on electrical theory, but he regretted the very complicated form in which Einstein expressed his theory, and hoped that it might be possible to put it into a form in which it would be more generally comprehensible and useful.

Dr. Silberstein laid great stress on the failure to confirm Einstein's third prediction, that of the displacement of lines in the sun's spectrum towards the red, to the amount of 1/20 Angström unit; this had not been verified, in spite of the careful search made by Dr. St. John and Mr. Evershed. As the probable error of the measures was much less than the quantity predicted, he looked on this

result as final; some people had suggested that the shift might be veiled by a systematic outward movement of the photosphere, but as Dr. St. John made measures both at the sun's center and limbs, that suggestion was not tenable. Professor Eddington admitted that the failure threw doubt on the validity of some of the steps which led Einstein to his gravitational result; but he contended that the two other successes indicated that the result was right, even if reached by a wrong method.

There was some discussion on Professor Lindemann's method of photographing stars in daylight by the use of red screens. However, the eclipse method seems more trustworthy, and the Astronomer Royal expressed the hope that the eclipse of 1922 might be observed with equatorials. The star-field is not so rich as in the late eclipse, but with longer exposure much fainter stars could be recorded. The eclipse-track crosses the Maldive Islands and Australia, and is therefore fairly accessible.

A. C. D. Crommelin

SCIENTIFIC EVENTS

INVESTIGATIONS ON INFLUENZA

The Metropolitan Life Insurance Company has provided resources to carry on investigations into the cause, mode of transmission and treatment of influenza and its complications.

A commission has been appointed consisting of Dr. G. W. McCoy, director of the hygienic laboratory, U. S. Public Health Service; Dr. W. H. Park, director of the research laboratory, New York City Department of Health; Dr. Lee K. Frankel, third vice-president of the Metropolitan Life Insurance Company; Dr. A. S. Knight, medical director of the Metropolitan Life Insurance Company; Dr. M. J. Rosenau, chairman, professor of preventive medicine and hygiene, Harvard Medical School. Later, Professor E. O. Jordan, of the University of Chicago, and Dr. W. H. Frost, of the U. S. Public Health Service, were invited to join in the work.

Work has already been begun in Washington, New York, Boston and Chicago and may be extended to other places as occasion arises. In this way correlation and cooperation are effected. The object of the commission is primarily to study the cause, mode of spread and treatment of influenza and its complications. Studies are now being made upon the prophylactic value of vaccines against influenza, common colds and pneumonia, properly controlled. Laboratory researches are being conducted to determine the cause of these infections, and a special study is being made of the bacterial flora of the upper respiratory tract in health and disease. Special consideration is being given to the possibility of a filterable virus being the cause of any of these infections. Cooperation and suggestions have been invited from health officers and others interested.

PROBLEMS OF FOOD AND NUTRITION

The National Research Council has formed a special committee on Food and Nutrition Problems, composed of a group of the most eminent physiological chemists and nutrition experts of the country. The members are: Carl Alsberg, chief, bureau of chemistry, Department of Agriculture; H. P. Armsby, director of the institute of animal nutrition, Pennsylvania State College; Isabel Bevier, director of department of home economics, University of Illinois; E. B. Forbes, chief, department of nutrition, Ohio Agricultural Experiment Station; W. H. Jordan, director, N. Y. Agricultural Experiment Station; Graham Lusk, professor of physiology, Cornell University Medical College; C. F. Langworthy, chief of office of home economics, Department of Agriculture; E. V. McCollum, professor of biochemistry, School of Public Health and Hygiene, Johns Hopkins University; L. B Mendel, professor of physiological chemistry, Yale University; J. R. Murlin, professor of physiology and director of the department of vital economics, University of Rochester; R. A. Pearson, president of the Iowa State Agricultural College; H. C. Sherman, professor of food chemistry, Columbia University; A. E. Taylor, Rush professor

of physiological chemistry, University of Pennsylvania; and A. F. Woods, botanist, president of Maryland State College of Agriculture.

This committee will devote its attention and activities to the solution of important problems connected with the nutritional values and most effective grouping and preparation of foods, both for human and animal use. Special attention will be given to national food conditions and to comprehensive problems involving the coordinated services of numerous investigators and laboratories. The committee, with the support of the council, is arranging to obtain funds for the support of its researches, and will get under way, just as soon as possible, certain specific investigations already formulated by individual committee members and sub-committees. These include studies of the comparative food values of meat and milk and of the conditions of production of these foods in the United States, together with the whole problem of animal nutrition; the food conditions in hospitals, asylums and similar institutions; the nutritional standards of infancy and adolescence; the formation of a national institute of nutrition; and other problems of similarly large and nationally important character.

THE ELIZABETH THOMPSON SCIENCE FUND

AT a meeting of the trustees of the Elizabeth Thompson Science Fund, held on Thursday, November 20, the following grants were voted: two hundred and fifty dollars to Professor Duncan S. Johnson, of Johns Hopkins University, for studies on the Development, Persistence and Growth of the Cactaceæ and Certain Myrtaceæ; two hundred dollars to Professor Antonio Pensa, of the University of Sassari, Italy, for investigations on the Cytology of Vegetable Cells; and three hundred dollars to Professor Lawrence J. Henderson, of Harvard University, for a research on the Heats of Reaction of Oxygen and Carbon Dioxide with Hæmoglobin solutions.

The Elizabeth Thompson Science Fund has been serviceable for many years in giving aid, by small grants, to research which otherwise might not be readily undertaken. The grants are made only for scientific investigations and must be applied to actual expenses of the research, *i. e.*, they are not made to support an investigator or to meet the ordinary expenses of publication. The trustees give preference to researches involving international cooperation. The grants are not made for researches of narrow or merely local interest, nor are they available for equipment of private laboratories or for purchase of apparatus ordinarily to be found in scientific institutions. Applications for grants from this fund should be made before January 15, 1920, to Professor W. B. Cannon, secretary of the trustees of the fund, Harvard Medical School, Boston, Mass.

ENDOWMENT OF THE MEDICAL SCHOOL OF VANDERBILT UNIVERSITY

ANNOUNCEMENT is made that the General Education Board of New York, has appropriated the sum of $4,000,000 for the purpose of enabling the Vanderbilt University to effect an entire reorganization of its medical school, in accordance with the most exacting demands of modern medical education.

The faculty of the medical school has for some years been urging upon the trustees of the university the necessity of radical and thoroughgoing organization, and it is promised its hearty and unconditional cooperation in the establishing of a new school of medicine in Nashville, as an integral department of Vanderbilt University.

Detailed plans for the new school have not as yet been developed, but they will unquestionably involve the completion of the present Galloway Memorial Hospital, with enlarged faculties for public patients, the erection in the near future of an additional hospital unit, the organization of a modern laboratory building, and the appointment of an increased number of professors, giving their entire time to the school and hospital, in both laboratory and clinical branches. Thus, not only will the endowment of the medical school be very greatly increased, but it will start its career with a modern and up-to-date plant—laboratory as well as hospital.

It is stated that this contribution by the

general education board comes from the general funds of the board, and not out of Mr. Rockefeller's recent donation of $20,000,000 for the promotion of medical education in the United States. The gift was in fact determined on before Mr. Rockefeller's recent gift was known.

THE ST. LOUIS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE opening general session of the association will be held on Monday night, December 29, at 8 P.M. in the Assembly Room of the Soldan High School. Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, will preside. General announcements concerning the meeting will be made, the revised constitution of the association will be presented for vote and the retiring president, Professor John Merle Coulter, of the University of Chicago, will deliver his address on "The Evolution of Botanical Science." The meeting will be followed by an informal reception to members of the American Association and of affiliated societies.

Registration headquarters, permanent and assistant secretaries' offices, meetings of the council, and all sessions of the association and the affiliated societies will be held in the Soldan High School. A directory will be conveniently placed in the main lobby and each room will be placarded indicating the various sessions.

There will be an information booth in Union station, where directions will be given for reaching hotels and meeting place. An attendant will be at booth at the time of arrival of all important trains on Sunday, Monday and Tuesday, December 28, 29 and 30. Hotel Statler will be the general headquarters. The local executive committee consists of George T. Moore, Alexander S. Langsdorf, Augustus G. Pohlman, John W. Withers and John M. Wulfing.

SCIENTIFIC NOTES AND NEWS

THE Royal Society has awarded its medals as follows: Royal medals to Professor J. B. Farmer for his work on plant and animal cytology, and to Mr. J. H. Jeans for his researches in applied mathematics; the Copley medal to Professor W. M. Bayliss for his contributions to general physiology and to biophysics; the Davy medal to Professor P. F. Frankland for his work in chemistry, especially that on optical activity and on fermentation; the Sylvester medal to Major P. A. MacMahon for his researches in pure mathematics, especially in connection with the partition of numbers and analysis; and the Hughes medal to Dr. C. Chree for his researches on terrestrial magnetism.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, has been elected an associate member of the Paris Academy of Sciences.

HONORARY membership diplomas and medals have been conferred by the Antwerp Zoological Society upon Professor Henry F. Osborn, president of the New York Zoological Society, and Dr. William T. Hornaday, director of the New York Zoological Garden, in testimony of its gratitude for a gift of animals sent to the Antwerp Garden.

DR. RAYMOND PEARL, professor of biometry and vital statistics in the School of Hygiene and Public Health of the Johns Hopkins University has been appointed statistician to the Johns Hopkins Hospital.

DR. WALTER VAN DYKE BINGHAM, director of the division of applied psychology of the Carnegie Institute of Technology, has been elected first chairman of the division of anthropology and psychology of the National Council of Research, and has been granted half-time leave until July 1, 1920.

DR. PAUL G. WOOLEY, professor of pathology in the college of medicine of the University of Cincinnati, has resigned.

LIEUTENANT COLONEL COERT DUBOIS, district forester at San Francisco, California, has resigned from the U. S. Forest Service and entered the Consular Service. Colonel DuBois has been a member of the Forest Service since 1900.

ELLSWORTH Y. DOUGHERTY has been appointed mining geologist in southern Oregon

for the Oregon Bureau of Mines and Geology.

DR. A. R. DAVIS, assistant professor of plant pathology and physiology, University of Nebraska, has accepted a position in the division of soil chemistry and bacteriology, University of California. Captain Davis has recently returned from France where he saw service with the heavy artillery.

IT has been stated in SCIENCE that G. B. Richardson has been placed in direct charge of the oil and gas section of the U. S. Geological Survey. Mr. Richardson has been placed in charge of the oil and gas section of the Division of Mineral Resources of the U. S. Geological Survey. Mr. David White remains at the head of the oil and gas section of the Division of Geology.

THE Observatory of Leiden is being enlarged and reorganized according to plans submitted by the new director, Professor W. de Sitter. It will henceforth consist of three departments—Fundamental Astronomy, Astrophysics and Theoretical Astronomy—with subdirectors in charge of the first two. Professor E. Hertzsprung has been appointed sub-director of the Astrophysical Department.

PROFESSOR ROBERT K. NABOURS, of the zoology department, Kansas State Agricultural College, has been given a year's leave of absence to make a third trip to Turkestan in the interest of the Karakul fur industry. During his absence Dr. James E. Ackert will be acting head of the department.

DR. EDWARD C. SCHNEIDER, formerly major in the Sanitary Corps, and now head professor of biology at Wesleyan University, Middletown, Conn., has been asked to continue as physiologist in charge of the physiological department of the medical research laboratory in the Air Service of the Army, at Hazelhurst Field, Mineola, L. I. He is giving two days of each week to this work.

DR. LOUIS A. BAUER gave an illustrated lecture on the "Solar Eclipse of May 29, 1919, and the Einstein Effect," before the Royal Astronomical Society of Canada at the University of Toronto, on December 2, and at the College of the City of New York on December 4, at noon. The lantern slides showed views of the solar eclipse and of various expeditions of the Department of Terrestrial Magnetism and of the astronomical expeditions sent out by the Smithsonian Expedition, Great Britain and Brazil, covering the belt of totality from Bolivia to the French Congo.

A HARVEY SOCIETY lecture will be given by Dr. E. C. Kendall, of the Mayo clinic, on "The chemistry of the thyroid secretion" at the New York Academy of Medicine on the evening of December 13.

DR. G. M. STRATTON, professor of psychology in the University of California, has accepted an invitation to deliver the Nathaniel W. Taylor Lectures at the Yale School of Religion, beginning April 12, 1920.

THE Lane medical lectures to be given by Dr. Alonzo E. Taylor, professor of physiological chemistry in the University of Pennsylvania, will have at their subject "The Feeding of the Nations at War." The titles of the lectures are:

December 8, "The problem of feeding a nation."

December 9, "The feeding of the United Kingdom."

December 10, "The feeding of France and Italy."

December 11, "The feeding of the enemy states."

December 12, "The food problem of Europe after the war."

THE executive committee of the Federation of Biological Societies, which includes the American Physiological Society, has called the annual meeting at Toronto, Canada, December 29, 30 and 31, 1919. The meeting is at the invitation of the University of Toronto. This is the thirty-second annual meeting of the American Physiological Society and it is hoped that this first post-war gathering may be made an epoch meeting. The meeting places of all the societies and the general offices of the federation will be in the medical building of the University of Toronto. Accommodations for approximately 200 members can be obtained by the local committee in the residences of the university and its colleges.

The Division of Industrial Research of the National Research Council is arranging for the formation of a cooperative association to plan and support fundamental researches in alloys. Although much valuable work has been done in this field by scattered investigators there is no doubt that a well-planned and coordinated effort by a cooperative association working under the general guidance of the National Research Council and composed of specialists representing both the manufacturers and the more extensive users of alloys can produce additional results of great importance. The success of other industries which have supported research on a cooperative plan, such as has been done by the National Canners' Association and the Malleable Iron Manufacturers, is evidence of this. It is planned to create a special scientific staff composed of a director and assistant director of research and a group of scientific investigators and technical experts who shall give their whole time to the work. To finance the organization each member of the cooperative association will pay $1,000 a year, and all contributing members, who may be either alloy manufacturing or using individuals, firms or companies are to benefit alike by the results of the researches.

UNIVERSITY AND EDUCATIONAL NEWS

McCoy Hall and others of the old buildings of the Johns Hopkins University were destroyed by fire on the night of November 27. The loss is covered by insurance, but valuable libraries and records of the school of hygiene and public health, which occupied the second floor of McCoy Hall, were destroyed with irreparable loss.

The main buildings of the University of Montreal, known as Laval University, containing the medical department, were destroyed by fire on November 22. The loss is estimated at $400,000, which is covered by insurance.

By an intensive campaign lasting less than a week the University of Rochester has raised $800,000 in the city of Rochester alone toward an endowment fund of one million dollars, the interest from which is to be used to increase professors' salaries. Mr. George Eastman, head of the Eastman Kodak Company, subscribed $100,000, the Bausch & Lomb Optical Company gave $75,000 and many other houses sums of lesser amount.

Dr. E. H. Kennard has been appointed assistant professor of physics at Cornell University.

Captain Esbon Y. Titus, formerly chief chemist for Nitrate Plant No. 1, Sheffield, Ala., has been appointed assistant professor of chemistry at the University of Wisconsin.

Francis Marsh Baldwin, Ph.D. (Illinois), assistant professor of zoology at Iowa State College for the past two years, has been raised to the rank of associate professor and has charge of the work in human physiology. Ralph L. Parker, M.S. (Brown), who served overseas for eleven months, is associated with Dr. Baldwin as an instructor.

Stuart Hobbs Sims, associate professor in the department of mechanics and hydraulics at the University of Iowa, will succeed C. B. McCullough as head of the department of civil engineering at the Oregon Agricultural College. Mr. McCullough has been appointed state highway bridge engineer for Oregon.

The Yale School of Forestry has received from Mrs. Claire K. Williams, of Lakeville, Conn., her interest in a pension fund of ten thousand dollars. This fund is given as a memorial to her son, Herbert C. Williams, who graduated at the School of Forestry as a loan for needy students.

DISCUSSION AND CORRESPONDENCE

AN APPEAL

During the night of November 27 fire completely destroyed McCoy Hall, formerly the administration building of the Johns Hopkins University, and immediately occupied by the Federated Charity Organization of the City of Baltimore, and certain departments of the

school of hygiene and public health of Johns Hopkins University. About three weeks ago the writer moved his department, that of biometry and vital statistics in the school of hygiene, into McCoy Hall, occupying the whole of the second floor of that building. On Thanksgiving Eve the writer had completed the removal to this building of all his private scientific library comprising roughly some fifteen thousand reprints and pamphlets. In the fields of biometry and genetics this library was in some respects unique owing to the fact that the writer began his activities in the field of biometry nearly twenty years ago when that branch of biological science was just getting under way, and consequently there was a completeness to the collection in that field which makes its total loss a catastrophe of overwhelming significance to the writer's scientific work.

In addition all the accumulated unpublished records of the writer's work for the past twenty years were completely destroyed. This included the records of his work in the genetics of poultry for ten years at the Maine Agricultural Experiment Station.

This second loss is, of course, wholly irremediable. The purpose of this note is to appeal to workers in the fields of genetics, biometry and vital statistics, to help in remedying the first loss in so far as it can be remedied by sending to the writer duplicates of such of their reprints as they may have available and which they were kind enough to send him before. Any help in this direction will be deeply appreciated.

RAYMOND PEARL
SCHOOL OF HYGIENE AND PUBLIC HEALTH,
THE JOHNS HOPKINS UNIVERSITY

SOMATIC VARIATION

THE undersigned are making a study of somatic variation, using for this purpose the duplicated portions of double monsters. We are especially interested at the present time in securing photographs or accurate sketches showing the color markings on double-headed calves or other double monsters in mammals characterized by color patterns. Any information as to the existence of such specimens from which records of this nature might be obtained would be greatly appreciated.

LEON J. COLE,
JESSIE MEGEATH
DEPARTMENT OF GENETICS,
UNIVERSITY OF WISCONSIN

STEINDACHNERIDION

IN 1888[1] we created the genus *Steindachneria* for three species of large catfishes from eastern Brazil; *St. amblyura* E. and E., from the Rio Jequitinhonha, *St. doceana* E. and E., from the Rio Doce and *St. parahybæ* Steindachner, from the Rio Parahyba. Our attention was at once called to the fact that Goode, in Agassiz' "Three Cruises of the Blake," had mentioned with a brief description and no type, if we recall correctly, a Macrurid under the name *Steindachneria*. With the rules governing nomenclature in those benighted times Goode's name had no standing and we wrote Goode calling his attention to the fact. Goode replied October 1, 1888: "*Steindachneria* has never been published, though the diagnosis of the genus has been lying in manuscript for nearly two years. So we will change the name. It is not of the least consequence."

When Goode and Bean's "Oceanic Ichthyology" was issued it appeared that Goode's intentions in regard to the Macrurid *Steindachneria* had not been carried out. Thereupon[2] we proposed the name *Steindachnerella* for the Macrurid.

Times and rules have changed. Dr. David Starr Jordan recently wrote us the catfish must have a new name. We sent him the letter of G. Brown Goode whereupon Jordan replies, "Goode's letter is very nice and characteristic. But under our present rules a *nomen seminudus* holds. . . . I recommend that you give a new name to the South American genus."

Reluctantly and with effort we submit to changing opinion, realizing that it is a long time since we began to give names to the fresh water fishes of South America. There-

[1] *Proc. Cal. Acad. Sci.* (2), I., 137.
[2] *Am. Naturalist*, 1897, p. 159.

fore, under the name *Steindachneridion* we rebaptize those catfish which, for thirty-one years have been nozing around on the river bottoms just north of Rio Janeiro under the improper appelation *Steindachneria*.

Carl H. Eigenmann,
Rosa Smith Eigenmann

ACOUSTIC EFFECTS OF WIRES

The thorough researches of Wallace C. Sabine, of Harvard University, showed that the acoustic qualities of a room depend largely on its reverberation times for various pitches, that is, the intervals during which the repeated echos of sounds remain audible. Good corrections can usually be made by altering the sound-absorbing qualities of walls and other surfaces against which the sound waves impinge and by which they are wholly or partially reflected.

Many attempts have been made, some within very recent times, to correct faulty rooms by stretching wires across them. There seems to be no reason for supposing, a priori, that a correction can be obtained in this way. To my knowledge no quantitative experiments to settle the question have been recorded. Many architects who have not given careful attention to the work of Sabine are inclined to believe that this method, because it has been used in so many instances, must give some degree of correction.

In the course of some experiments which I made a few months ago on the faulty acoustics of the chamber of the House of Representatives in the new parliament buildings in Wellington, New Zealand, I was requested to make an experiment on the effect of wires. The committee in charge of the work knew that a chamber in the Australian parliament buildings had been fitted with wires and that they were said to function well.

No. 16 copper wires were stretched both lengthwise and crosswise six inches apart in a horizontal plane over the entire middle part of the room bounded by the galleries. This space constitutes two thirds of the cross-section of the room. 9,000 feet of wire were used, possibly twenty times as much as would ordinarily be used in a room of this size. The reverberation times for a great variety of pitches were carefully measured both with and without wires, and were found to be the same in both cases to within about two per centum, which is not greater than the expected error of measurement.

In this particular case, therefore, the wires were without effect. I have not been able to discover any uniformity in the arrangements of wires where they have been used, and so the one described above may be considered as good as any. The probability is great that wires, however arranged, have no effect on acoustics.

Harry Clark

Oberlin College

QUOTATIONS

THE HARVEIAN FESTIVAL OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON

The Harveian Festival was, for the first time since 1913, celebrated with full honors by the Royal College of Physicians of London on St. Luke's Day (October 18). The Harveian Oration has been delivered each year, but the other ceremonies have been intermitted. On this occasion the oration, delivered by Dr. Raymond Crawfurd, dealt with the forerunners of Harvey in antiquity. As will be seen when the full text is published in an early issue, the speaker supported the thesis that in the matter of the circulation of the blood Harvey's indebtedness to any but Aristotle was negligible. The fuller knowledge now possessed of the writings of men of science of ancient days demanded, he said a readjustment of traditional beliefs, for too much had been claimed for the ardent anatomists of the Renaissance and too little conceded to the master minds of antiquity. The oration was delivered in the library, and the speaker's development of his theme was closely followed by a large and attentive audience. Afterwards the President presented the Baly Medal to Dr. Leonard Hill, and in doing so recalled the circumstances of its foundation. William Baly was assistant physician to St. Bartholomew's Hospital, a Fellow of the

Royal Society as well as of the Royal College of Physicians, and had attained a leading position in London when he was killed in a railway accident in 1861. Five years later Dr. Dyster presented a sum of money to the college to found a medal in Baly's memory, to be given every two years to the person deemed to have most distinguished himself in the science of physiology, especially during the two years preceding the award of the medal. The first recipient was Richard Owen; among the others were William Sharpey, Charles Darwin, Sir David Ferrier, Sir Michael Foster, Dr. W. H. Gaskell, Sir Edward Sharpey Schafer, Professor E. H. Starling, Professor Halliburton, Dr. J. S. Haldane, Professor Gowland Hopkins, and Professor W. M. Bayliss. But the medal is not restricted to British subjects, and has been awarded at various times to Claude Bernard, Carl Ludwig, R. Heidenhain, M. Schiff, Professor Pavloff (the Russian physiologist), and Professor E. Fischer. Harvey, in giving the college his patrimonial estate of Burmarsh, in Kent, in 1656, just a year before his death, enjoined that once every year a general feast should be held within the college, and that on that day an oration should be delivered exhorting the fellows and members to search and study out the secrets of Nature by way of experiment, and also, for the honor of the profession, to continue in mutual love and affection among themselves, ever remembering that *concordia res parvæ crescunt, discordia magnæ dilabuntur.* It has been the practise of the college to obey this injunction by holding a dinner of the fellows, to which the guests are invited, on St. Luke's Day. Such a dinner was held on October 18. The President (Sir Norman Moore), in proposing a toast to the guests, dealt briefly with the changes and terrible events of the years since 1913, and remarked incidentally that the college had been prevented from celebrating as it would have wished the quatercentenary of its foundation, which fell on September 28, 1918. In happy sentences, illumined by many historical references, he showed how the college had always manifested its attachment to literature. He reminded hearers that Linacre—who, with the aid of Cardinal Wolsey, obtained from Henry VIII. the charter of incorporation—was one of the earliest Greek scholars in this country, and the friend of such men as Erasmus, More and Tunstall. Ever since the college had shown its attachment to learning, and had never wanted among its fellows men of literary distinction and wide scholarship. The toast was acknowledged by Sir J. J. Thomson, President of the Royal Society, who vindicated the claims of medicine to be accounted an independent science, bringing to its task for the prevention and relief of human suffering special methods of observation and experiment, upon which the art of the physician is founded. The toast was acknowledged also by Mr. J. C. Bailey, the editor of Cowper. The health of the Harveian orator was given in a brilliant and sympathetic speech by the senior censor, Sir Wilmot Herringham, and briefly acknowledged by Dr. Crawfurd.—*The British Medical Journal.*

SCIENTIFIC BOOKS

Konchûgaku Hanron Jôkwan (General Treatise on Entomology). By. Dr. T. Miyake. Shokabo, Nihonbashi, Tokyo, Vol. II., 1919.

In Science for August 3, 1917, is published a brief review of the first volume of this excellent work by Dr. Miyake, of the Imperial Agricultural Experiment Station at Nishigahara, Tokyo. The second volume has just appeared, and includes a discussion of insects' relations to plants, animals and man, with methods of general study, classification and collecting. It also includes a history of entomology in foreign countries and also in the older days in Japan. Although published in Japanese, much of it will be intelligible to the American reader through the abundant illustrations, which, of course, constitute a universal language. Dr. Miyake expects to publish two additional volumes, and the work as a whole will be an admirable compendium for the students of entomology in Japan. He has done pioneer work in many directions, the educational value of which is very high.

L. O. Howard

SPECIAL ARTICLES

GERMINATING FRESHLY HARVESTED WINTER WHEAT

Frequently only a small percentage of freshly harvested winter wheat germinates readily under the conditions ordinarily used in making the germination tests even though it would germinate well under these same conditions a few weeks later. In sections of the country where farmers depend upon wheat from the current crop for the fall sowing the poor germination secured with the fresh grain has made it difficult for seed analysts to give accurate information as to the quality of winter wheat offered for seed in time for this information to be of service.

In a recent investigation by the Seed Testing Laboratories of the United States Department of Agriculture it has been found that the difficulty described in the preceding paragraph can be almost entirely overcome even with wheat taken from standing plants and never allowed to dry out by the use of a lower temperature than has been customary for making the germination tests. Thus of 16 samples of freshly harvested wheat an average of 99 per cent. began to germinate in 5 days at temperatures from 9° to 16° C. (48° to 61° F.), whereas in the same time an average of only 86 per cent. germinated at 22° C. (72° F.) which is about the temperature at which germination tests of wheat are frequently made. In the case of one lot 98 per cent. were germinating by the end of 5 days at 12° C. (54° F.) and only 16 per cent. at 22° C. (72° F.). About 15° C. (59° F.) is recommended for use in making germination tests of all freshly harvested wheat. Of course at this temperature the rate of growth is slow after germination has begun. However, if one wishes to assure himself of the normal character of the seedlings it is only necessary to transfer the wheat grains as soon as the coverings are split over the embryo to some place where the temperature is about 20° C. (68° F.) and leave them at the higher temperature for a day or two.

A number of other methods have been discovered of overcoming this difficulty, at least partly, but none is as satisfactory as the use of a low germination temperature. Removing the coats over the embryo by the use of concentration sulphuric acid, followed by neutralization of the acid and washing, and a number of mechanical treatments which consist essentially of exposing the embryo to external conditions have been markedly successful, but are all tedious and some of them are attended with great danger of subsequent decay of the grain.

Drying the wheat at about 40° C. (105° F.) for a week had a somewhat beneficial effect upon its germination, but this method of treatment does not give wholly satisfactory results and, together with the following germination test, consumes more time than can be allowed, especially toward the end of the fall sowing season.

All of the methods which were beneficial with winter wheat gave equally good results with spring wheat and all except treatment with sulphuric acid were used with more or less success also in the germination of freshly harvested barley and oats, with which the same difficulty may be experienced as with wheat.

A full report of the investigation is to be published shortly by the United States Department of Agriculture.

George T. Harrington

Bureau of Plant Industry,
U. S. Department of Agriculture

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CONTENTS

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THE CARNEGIE INSTITUTION OF WASHINGTON[1]

WHEN the armistice was agreed to by the contending nations in November, 1918, the Institution had become more of an agency for the promotion of warfare than one for the promotion of peaceful pursuits. About two thirds of the staffs connected directly with the Institution, or somewhat more than 200 men, were engaged in war work, and about the same proportion applies to the Research Associates of the Institution and their collaborators. Nearly every expert of the institution was able to render assistance and many of them devoted their entire time and energies to government work. Of the larger undertakings in this work, the most conspicuous are the development to the point of quantity production of the optical glass industry by the Geophysical Laboratory; the manufacture of precision micrometers for the U. S. Bureau of Standards and the manufacture of optical adjuncts for artillery by the staff of the Mount Wilson Observatory; the construction of special devices for the Navy in the shops of the Department of Terrestrial Magnetism; the contributions of the Nutrition Laboratory to knowledge of the effects of undernutrition; and the information service rendered by the Department of Historical Research. These undertakings required many men in arduous researches and involved no inconsiderable costs to the institution, since it assumed, in most cases, the principal overhead expenses. Not less important relatively than these larger operations were many special and individual contributions to the general cause. That essential occupations were quickly developed for what are sometimes called "narrow specialists" in nearly every branch of learning cultivated by

[1] From the report of the president, Dr. R. S. Woodward, for the year ending October 31, 1919.

the institution affords striking evidence at once of the diversity of modern warfare and of the ultimate practical value of recondite researches.

Although formal requests from the government for services ceased nominally toward the close of the calendar year 1918, they actually continued until nearly the middle of 1919. Thus, the optical work and the researches on the concentration of nitrates for the War Department did not end until June, 1919; the information work of the Department of Historical Research continued until mid-July; some special work for the Navy was done by the Department of Terrestrial Magnetism as late as September of this year; while a few other relations in government undertakings still remain to be served. It is only recently, also, that members of the institution in the military and other services of the government have returned to their posts; so that emergence from the untoward conditions in which we find ourselves has only fairly begun.

Naturally, this deflection of interest from the normal activities of the institution has led to many changes, to some dislocations, and to the suspension, or even abandonment, of a number of projects. The war, in fact, has brought some sinister consequences to the institution as well as to most other organizations. Fortunately, of those who entered the military and naval service only two lives were lost, namely, Karl Edward Anderson and Billings Theophilus Avery, both of the Department of Experimental Evolution, who died during the year 1918. Fortunately, likewise, while some members of the investigatory staffs of the departments of research have been drawn off, by reason of their abilities, into industrial or other occupations, the number of such is not only small but not in excess of an inevitable and healthy exchange between a progressive establishment and its contemporaries.

Detailed reports concerning the war activities of the institution, and particularly concerning the work done by the departments of research, are on file in the office of administration; so that if it should become necessary to publish an account of these activities the essential data are at hand. The time for publication of such an account does not appear to have arrived, since the government is entitled to initiative and priority in all these matters.[2] Hence only the briefest references to them are made in this and other parts of the current Year Book.

It should go without saying that the disturbed conditions, social, industrial, economic and governmental, under which the world is now laboring are not without untoward effects on the institution. Being a part of and not apart from contemporary life, it must share to a greater or less extent in the consequences which follow from an unparalleled attempt at national supremacy based on the desperate doctrine of "dominance or downfall." But obvious as these consequences are in the abstract, there appear to be many outside and some within the institution who think that it may continue to expand regardless of the limits of its income and regardless of the fact that the purchasing capacity of this income has diminished by one half during the past decade. In line with these vagaries there is a recrudescence also of the juvenile notion so commonly held of the institution in its earlier years, that it may play the rôle of paternalism for other establishments and for individuals, and that it may act generally as a salvager in the wreckage of the world. Similarly, just as in political affairs it is often assumed that the prevailing scarcity of necessities and the burdens of taxation may be relieved by other means than by productive labor, so it is assumed that the institution may meet the increasing costs of its operations, not by appropriate restrictions and economies, but by increasing appropriations drawn from mythical sources. Thus the distribution of necessary disappointment, which has been so large a part of the unproductive business of the administrative office hitherto, is now increasing, stimulated by two generations of men unaccustomed to the practise of

[2] A concise history of the production of optical glass is given by Dr. Fred E. Wright (major, Engineer Corps, U. S. A.), of the staff of the Geophysical Laboratory, in "America's Munitions," published by the War Department in 1919.

thrift and justified by the widely prevalent but immoral theory that the institution may proceed "regardless of expense."

THE HOOKER TELESCOPE

One of the distinct, if relatively unimportant, misfortunes of the world war was the delay in testing the capacities of the 100-inch telescope named after Mr. John D. Hooker, of Los Angeles, who made the initial contribution toward the construction of this instrument thirteen years ago. It was substantially completed shortly before the United States became a participant in the conflict. About this time, also, the director of the Observatory became chairman of the National Research Council and he continued to give all his time to this governmental organization until May of this year. In the meantime, likewise, as already indicated, the staff of the observatory was preoccupied largely with military rather than with astronomical affairs. Hence, opportunity has only recently arrived for determination of the critical question whether this "largest telescope," which is 28 inches larger than its largest predecessor, and 40 inches larger than the highly successful 60-inch instrument completed by the observatory in 1908, would meet expectations in optical capacity and practicability of operation. The construction of so large a telescope has been regarded as one of the hazardous undertakings of the institution. Its optical perfection depends on the stability of the glass used for its mirror; the stability of the latter depends in turn on the rigidity of its mountings; the requisites in both cases must take into account the elastic mobility of materials and the disturbing effects on them of temperature changes; and all these considerations must unite to secure a combination which is manageable. The problems in engineering thus presented have appealed very strongly to all parties interested in such constructions, perhaps almost as strongly as the astronomical possibilities anticipated from such an extensive addition to visual apparatus. But the director of the observatory now reports that the optical and the engineering difficulties have been overcome and that the instrument under repeated tests has proved efficient quite beyond the conservative theoretical predictions of attainable capacities.

THE NON-MAGNETIC SHIP

As related in the report of the preceding year, it was deemed expedient, in April, 1917, on account of dangers to navigation, to suspend the cruise contemplated by the Department of Terrestrial Magnetism for additional surveys in the Atlantic Ocean by the ship *Carnegie*. As related also in that report, this ship was brought safely, by way of the Pacific Ocean and the Panama Canal, to the port of Washington, District of Columbia, arriving there June 10, 1918. She lay here until the spring of 1919, when it was decided to send her out again on her mission as soon as necessary repairs and alterations could be made. Of the alterations required, the most important was the adaptation of her engine for auxiliary propulsion to the use of gasolene as fuel. When the ship was launched, in 1909, it was easier to get anthracite coal than gasolene or other liquid fuel in remote parts of the world. Hence the engine was constructed to use gas derived from such coal by the so-called producer process. In the meantime, anthracite coal has become much less and gasolene much more accessible at distant seaports, and this circumstance has led to the noteworthy, and in these times expensive, but highly advantageous change here specially referred to. After delays which serve to emphasize the inefficiency of mankind under post-war conditions, on October 19, the *Carnegie*, under the command of Mr. J. P. Ault, put to sea from the Virginia Capes, on her sixth cruise, to comprise surveys in the Atlantic and Indian Oceans not yet adequately covered by previous circuits.

PUBLICATIONS OF THE YEAR

Of all branches of the institution the one least affected by the war is the Division of Publications. Although it has undergone some changes in staff and encountered the obstacles due to a rapid rise in the costs of printing and illustrations, its work has gone

on without serious interruption; and the output of books for the year, as may be seen by reference to the detailed list given in a later section of this report, is rather greater than the average annual output for the past decade. Of the entire list of twenty-nine volumes issued, only two classes of them, selected mainly for the purpose of showing trends of progress, may be referred to here.

The most elementary, the most essential, and hence the most widely used, if not esteemed, of the sciences is arithmetic. It is a fundamental requisite, in fact, of all exact knowledge. Ability to add, subtract, multiply, and divide affords probably the simplest test of capacity for correct thinking. Conversely, inability or indisposition to make use of these simple operations affords one of the surest tests of mental deficiency, as witnessed, for example, by numerous correspondents who are unable to or who refuse to apply these operations to the finances of the institution. But the familiar science of arithmetic lies at the foundation also of a much larger and a far more complex structure called the theory of numbers. This theory has been cultivated by many of the most acute thinkers of ancient and modern times. It has more points of contact with quantitative knowledge in general than any other theory except the theory of the differential and integral calculus. These two theories are complementary, the first dealing with discrete or discontinuous numbers and the second with fluent or continuous numbers. Naturally, a subject which has attracted the attention of nearly all of the great mathematicians of the past twenty centuries has accumulated a considerable history. The more elementary contributions of Euclid, Diophantus, and others of the Greek school; the extensions of Fermat, Pascal, Euler, Newton, Bernoulli and many others in the seventeenth and the eighteenth centuries; and the work of Lagrange, Laplace, Gauss, and their numerous contemporaries and successors of the nineteenth century, make up an aggregate which has stood hitherto in need of clear chronological tabulation and exposition. This laborious task was undertaken about ten years ago by a Research Association of the Institution, Professor Leonard E. Dickson, of the University of Chicago. A publication under the title "History of the Theory of Numbers" has resulted, and Volume I. (8vo, xii + 486 pp.), devoted to divisibility and to primality of numbers, has appeared during the past year; and a second volume devoted to diophantine analysis is now in press. This work is remarkable for its condensation of statement. It contains more information per unit area than any other work issued thus far by the institution. It is remarkable also for the care taken by the author and by his collaborators to secure precision and correctness, a number of experts having assisted in the arduous labors of verification required during the process of printing.

It is the object of science primarily to find answers to the question "How?" rather than to the question "Why?"; or, to seek to describe phenomena rather than to try to explain them. Words, however, constitute, in general, a rather imperfect medium for the communication of ideas, and as a consequence the intellectual world, like the political world, often finds itself involved in misunderstandings which lead to nothing better than that metaphorical and degenerate form of energy called the heat of controversy. Thus, about a half-century ago there arose, as we now see, a quite needlessly bitter discussion over the question whether and to what extent the phenomena of life may be traced back to the properties of matter with which they are obviously intimately associated. The new science of biology was just then arising and the limitations of its domain and the conditions of its existence and development were widely disputed, as is best shown probably by the lay sermon of Huxley delivered at Edinburgh November 8, 1868, "On the Physical Basis of Life." In this remarkable address Huxley defines, with prophetic clearness and completeness, the limitations and the conditions in question and these, as he defined them, are now generally admitted as essential to all fruitful inquiry. Moreover, the principles expounded by Huxley have been justified in amplest measure by the extraordinary

progress since accomplished, not only in biology, but in all the physical sciences.

It is good fortune for a research establishment to have been founded during the course of this progress and to be able to take part in it; and although the publications of the institution are not restricted to any domain of learning, a considerable number of them bear directly or indirectly on this profoundly interesting and increasingly important problem of "the physical basis of life." The past year has been unusually productive in this line, for no less than a dozen volumes have been added to the institution's series of contributions to evolution, heredity, and the application of thermodynamics to the interpretation of metabolism in man. These contributions are particularly noteworthy also for the extent to which cooperation has been required, since more than twenty authors and more than twice that number of collaborators are represented in the dozen volumes referred to.

THE SIGNIFICANCE OF THE DECLINING BIRTH-RATE —A REPLY[1]

Members of Section I in attendance at the meeting last year will recall the address of the retiring vice-president and chairman of the section. This meeting offers a suitable opportunity to present at least one of the replies which such an address might be expected to call forth.

Seventy per cent. of Mr. Dublin's paper was occupied with statistics, and these we may accept as coming from an expert statistician. It is the remaining thirty per cent.—embodying the author's view of the *significance* of the declining birth-rate—that invites attention.

To begin with, I hardly need point out the necessity of recognizing the prevalence of multiple and compound causes in all fields of social phenomena. When a compound cause has been disentangled from a mass of observations its individual factors must be carefully weighted in order to give proper prominence to the chief one. Mr. Dublin arraigns the women and their education for the declining birth-rate. In so doing he involves himself in a significant concession; and one wonders how, with so much of a clue, he has failed to perceive the true interpretation of the social feature which he deplores. He has fixed his attention on very minor and limited causes only to lose sight of the great generic cause.

For we are to-day in the midst of a revolution quite unparalleled in the history of the human race—whether it be viewed as regards the number of persons concerned, or the length of its preparatory prelude, or the importance of the consequences which will undoubtedly follow it. I refer to the movement connected with the discovery that women, in spite of being females, are primarily human beings, with the same desires for freedom and self-direction, the same ranges in tastes and abilities and ambitions, that men have. This discovery is due to woman's recently acquired opportunity for knowledge and opportunity for economic self-dependence. These opportunities themselves seem to be involved first as effects and then as causes in modern human progress. The evolution of society—civilization itself—had proceeded as far as it could, with the archaic status of woman unmodified.

Folklore and literature from earliest times to very recent days have been charged with positive expressions of the place and duty of the female. Radical writers and conservative ones alike, teachers, philosophers, statesmen and poets, have—with few exceptions—been agreed that that place was home and that duty the care of the home and the rearing of children. Very naturally all schemes of government and all systems of theology have been in harmony with this popular conviction. To cook a thousand meals a year, to make beds and wash dishes a thousand times a year, to bear children—always to bear children—in meekness and resignation, has been held to be the woman's lot as ordered by Providence or at least by Nature. What else could a normal woman want to do?

[1] Read before Section I (Social and Economic Science) of the American Association for the Advancement of Science, Baltimore, December 27, 1918.

If reiteration could save a doctrine or confer the attribute of truth this doctrine would not now be moving to join its companion superstitions: Special Creation and the Fall of Man. The savage with his savage job of hunting and fighting made the inferences that might be expected from a primitive mind regarding the creature who staid at home to cook his food and care for his child: one who could not—or at least did not—fight was inferior. The reasoning of post-savage and post-barbarous peoples is an extraordinary mass of testimony to the slowness with which the human mind has advanced to scientific aptitude. Philosophers, theologians and statesmen—no less than common persons—have failed to perceive that *no conclusions based on observations of unfree human subjects can safely be drawn regarding what is normal in those subjects.* Failure to recognize this principle accounts for the surprise, the dismay and the disapproval upon witnessing among free woman what is apparently most unnormal behavior; that is, behavior inconsistent with the normal or type-form as it had been understood.

In the United States, as late as 1850, women—being without other means of securing food, clothing and shelter—married on terms not of their own making. They bore children according to the pleasure of those whom they were to obey and in recognition of a dogma of theology which they were taught to hold as divinely endorsed. For, lacking knowledge, women were no more free in mind than they were in body lacking economic independence. This type of woman has practically disappeared below the historical horizon—succeeded by a multitude of women of affairs, in gainful occupations, in the activities of business, philanthropy, education, professions and in concerns that require the highest order of organizing and administrative ability—women who offer no apology for their choices and no defense of their activities.

Now, the most noticeable consequence of the new freedom is that each woman is deciding for herself whether she will marry or not. And in case she does marry, the deciding vote as to the number of children to follow is likely to rest with her. The woman of to-day will herself determine what her duty is in the case. We may reason with our equals or appeal to them; but for one person to tell another grown-up person his duty, or for one class of persons to dictate the duties of another class, seems now to be unsustained by ethical courtesy. Justice has reached the point of insisting that as regards bearing many or any children a woman must be free to decide—free from the coercion of government, or religion, or public opinion, or a disordered conscience.

That "revolution" is not too strong a word to mark what has taken place in two incomplete decades of the twentieth century is well indicated by comparing the war-time position of women in the past with that of the present. The lady of the nineteenth century and all preceding ones waited and wept at home and prayed for her lord's safe return from the wars. To-day history takes into her keeping the story of the multiple *Entente* of women who helped to win the Great War. The sudden need that women should come out of the home and lend a hand in a hundred ways has led to an unexpected and perhaps unwelcome proof of what they will usually do as free persons. No doubt there are those who find consolation in the thought that women's war activities have been a spasmodic though commendable expression of patriotism, a temporary estrangement from their true work and, the war over, they will return to their "normal" place: the home. It may readily be admitted that the new freedom is too new to permit of immediate conclusions. Sociology no less than geology or physiology or any other science requires us to suspend judgment. All that can be asked on the one hand, all that need be granted on the other, is that in the great laboratory which we call human society the class investigated, the women, shall be free. A provisional judgment is that while many women will probably prefer to devote themselves to domestic activities, many others will be equally inclined—and resolved—to occupy themselves with the varied pursuits which have hitherto

been claimed by men alone. The statistics of the Census of 1920 will contribute much to the discussion. Meanwhile it must be disconcerting to reactionary persons to observe how many young women are disposed to do the very thing for which young men are commended; namely, to select a line of work and carry it through to success.

But the declining birth-rate. If n is the number of births per thousand per year and n' the number of deaths per thousand per year of children, say under one year of age, $n-n'$ is the effective birth-rate. Obviously this can be raised by increasing n or by diminishing n'. To increase n has been the way of barbarism. "What if the children do die; the woman can bear plenty more." This is not the sentiment of some distant past age; for, as Francis Galton remarks, men were barbarous but yesterday.

The method of the new civilization is to decrease n'. Up to last July (1918) the Federal Children's Bureau had weighed and measured approximately six million children under six years of age. A large number were were found to be undernourished; many others were victims of diseases easily remedied by proper medical attention. Under the auspices of this bureau nation-wide plans are developing to provide public health nurses, better hospital care and the conservation of milk for children. It appears also that really effective means for saving the young children involves care of the mother not only after the child's birth but also months before.

"Save 100,000 of the 300,000 children that now die annually under one year of age!" is not the slogan of a few sentimental philanthropists; it is the purpose of the national government. This federal bureau further reports that 15,000 women die annually in the United States from childbirth; and it declares that of this total most of the deaths are preventable because due to ignorance and improper care. Nothing in this world has been so cheap as child-life except mother-life.

But I now squarely challenge Mr. Dublin's fundamental assumption that a declining birth-rate is an evil. What reason does he give, what reason has anybody given, why the hither and the uttermost parts of North America say, should forthwith be populated as rapidly and as densely as may be—even by elect stock. Why should the natural forests be so hurriedly worked into lumber and the country's non-restorable natural resources—coal, petroleum, gas and others—be exploited to the exhaustion point? Has the United States any grounds for felicitating herself on the fact that she is burning coal at the rate of 600,000,000 tons per year? And how many years may she expect to continue such self-felicitations? It is the crudest form of collective selfishness for any one generation to act as if it had a final lien on the earth when at best it is only a temporary tenant, in honor bound by the highest racial ethics to consider the interests of those who follow: the peoples of distant centuries. This generation more than any which has preceded it seems bent on bequeathing an impoverished domain to its "heirs and assigns forever." "Few men really care what happens to posterity."

Your vice-chairman's protest against any decrease in the birth-rate meets rebuke also in the condition of the congested points where most of the increase in population is to find its home: the city. Are the city's streets—all of her streets—clean and attractive? Are her homes—all of her homes—sunny and sanitary? At what age do her children leave the public schools, and why do they leave? What are the hours and wages of young women in her laundries, candy-shops, stores, restaurants and factories? Are her women citizens no longer discriminated against as political outlaws? Has the city figured out a minimum of subsistence, of health, of education, of leisure, for all of her citizens? Until these questions are satisfactorily answered the "socially and economically efficient class" may well address itself to the practical task of bettering the conditions of human living rather than to an effort to state the population of the city in six figures instead of five.

Mr. Dublin's theory that the country will be saved if the afore-mentioned "socially and economically efficient" will only marry and raise large families runs counter to facts, for facts show that permanent betterment can

not be achieved by so simple a device as quantitative displacement. Indeed, society has always paid a price of defeat when it has attempted to nurture, through mere descent, a so-called better class superposed on a class of alleged inefficients. A group, *a*, socially and economically efficient has no guaranty that an offspring group, *a′*, will be likewise superior. What is "good blood" anyhow? It is that blood which manifests the skill and purpose to behave uprightly as a member of civilized society. But behavior can not be calculated in advance like the ephemeris of a comet. It lies outside the realm of any law of heredity as yet disclosed; for in the sequel the first of blood are apt to be last and the last first.

Mr. Dublin's contrast of native-born stock with foreign-born to the disadvantage of the latter is especially unjustified by facts. The most "native" of us are not so very native that we can with any propriety look with disdain on the great numbers of devoted and able citizens of the United States who happen to have been born on the east side of the Atlantic.

It is too late now to evade the business of defining "democracy." The Reconstruction Program of the British Labor Party—probably the most important document which world conditions have brought into existence during the past five years—starts us on the way to a definition by reciting that "the first condition of democracy is effective personal freedom." "Effective personal freedom" is a mocking phrase unless it means freedom to choose one's work, to choose one's forms of service, and to live one's life not hindering others and not hindered by others. Whatever it costs of traditions and prejudices and theories democracy requires now that there be no subject race, no subject class and no subject sex. Mr. Dublin does not seem to grasp this idea. He appeals to government, to religion, and to the schools, to return woman to what he believes to be her sphere. But governments, religions and schools do not originate or lead world movements; they follow and if they are wise they accept the inevitable. The movement briefly denoted by the phrase, "freedom of women," is here because its time had come. Constitutions of governments, creeds of religions, curriculums of schools, are adjusting themselves to its requirements.

A study of the folk-customs of savage tribes has brought to light a system of tabu which amounts to strangerhood between men and women in all relations except the sex relation. The new society, the Great State, will show strangerhood replaced by comradeship. Men and women will together own the earth and together administer human affairs—all human affairs. It is plainly so written on the scroll which evolution unrolls.

ELLEN HAYES

WELLESLEY, MASS.

SCIENTIFIC SOCIETIES MEETING AT ST. LOUIS

THE following societies have indicated their intention to meet in St. Louis during Convocation Week in affiliation with the American Association for the Advancement of Science:

Mathematical Association of America.—(Missouri Section.) December 29. President, H. E. Slaught; Secretary, Professor Paul R. Rider, Washington University, St. Louis, Mo.

American Mathematical Society.—(Chicago and Southwestern Sections.) December 30 and 31. Joint session with Section A on December 30. Acting Secretary, Dr. Arnold Dresden, 2114 Vilas St., Madison, Wis.

American Federation of Teachers of the Mathematical and the Natural Sciences.—Secretary, Dr. William A. Hedrick, Central High School, Washington, D. C.

American Meteorological Society. December 29 to 31; joint meetings with Sections B and E on dates to be announced. Secretary, Dr. Charles F. Brooks, U. S. Weather Bureau, Washington, D. C.

American Physical Society.—December 30 to January 1, in joint session with Section B, President, J. S. Ames. Secretary, Dr. Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

Society for the Promotion of Engineering Education.—President, Arthur M. Greene, Jr. Secretary, Professor Frederic L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Optical Society of America.—January 2. Presi-

dent, F. E. Wright. Secretary, Dr. P. G. Nutting, Westinghouse Research Laboratory, East Pittsburgh, Pa.

Association of American Geographers.—December 30 to January 1. President and Acting Secretary, Dr. Charles R. Dryer, Oak Knoll, Fort Wayne, Ind.

National Council of Geography Teachers.—December 29 and 30. President, Albert P. Brigham. Secretary, Professor George J. Miller, State Normal School, Mankato, Minn.

American Society of Zoologists.—December 29 to 31, in joint session with Section F. Joint session with Ecological Society of America on Tuesday afternoon, December 30. Zoologists' dinner, with address of Vice-president of Section F and moving picture films of Barbadoes-Antigua Expedition by C. C. Nutting, on Wednesday night, December 31. President, C. M. Child. Secretary, Dr. W. C. Allee, Lake Forest College, Lake Forest, Ill.

Entomological Society of America.—December 29 and 30. President, J. G. Needham. Secretary, Dr. J. M. Aldrich, U. S. National Museum, Washington, D. C.

American Association of Economic Entomologists.—December 31 to January 2. President, W. C. O'Kane. Secretary, Albert F. Burgess, Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass.

Botanical Society of America.—December 30 to January 1, with joint sessions as follows: Tuesday, December 30, Section G; Wednesday, December 31, American Society for Horticultural Science; Thursday, January 1, 10 A.M., Ecological Society of America, 2 P.M., American Phytopathological Society. On Wednesday night, December 31, will be the annual dinner for all botanists, followed by presidential address. President, J. C. Arthur. Secretary, Professor J. R. Schramm, N. Y. State College of Agriculture, Ithaca, N. Y.

American Phytopathological Society.—President, C. L. Shear. Secretary, Dr. G. R. Lyman, U. S. Department of Agriculture, Washington, D. C.

American Society for Horticultural Science.—December 29 to 31. President, J. W. Crow. Secretary, Professor C. P. Close, College Park, Md.

Association of Official Seed Analysts.—Will meet on Monday and Tuesday, December 29 and 30. President, H. D. Hughes. Secretary, R. C. Dahlberg, University Farm, St. Paul, Minn.

Ecological Society of America.—December 30 to January 1, with joint session with the American Society of Zoologists on Tuesday, December 30, and with Botanical Society of America on Thursday, January 1. President, Barrington Moore. Secretary, Dr. Forrest Shreve, Desert Botanical Laboratory, Tucson, Arizona.

American Pomological Society.—December 30 to January 1. President, L. H. Bailey. Secretary, Professor Edward R. Lake, Hotel St. Nicholas, Albany, Ga.

American Microscopical Society.—December 30, for luncheon and executive committee and on Wednesday, December 31, for business meeting just following Section F afternoon session. President, L. E. Griffin. Secretary, Professor Paul S. Welch, University of Michigan, Ann Arbor, Mich.

American Nature-Study Society.—December 30. President, L. H. Bailey. Secretary, Dr. Anna Botsford Comstock, Cornell University, Ithaca, N. Y.

Wilson Ornithological Club.—December 29 and 30. President, Myron H. Swenk. Secretary, Professor Albert F. Gainer, 924 Broadway, Nashville, Tenn.

American Metric Association.—December 29 and 30. President, George F. Kunz. Secretary, Howard Richards, Jr., 156 5th Avenue, New York, N. Y.

Society for the Promotion of Agricultural Science.—Secretary, Dr. C. P. Gillette, Colorado Agricultural College, Fort Collins, Colo.

Society of Sigma Xi.—President, Julius Stieglitz. Secretary, Dr. Henry Baldwin Ward, University of Illinois, Urbana, Ill.

Gamma Alpha Graduate Scientific Fraternity.—President, Norman E. Gilbert. Secretary, Dr. Albert H. Wright, Cornell University, Ithaca, N. Y.

Phi Kappa Phi.—December 31. President, Edwin E. Sparks. Secretary, Dr. L. H. Pammel, Iowa State College, Ames, Iowa.

Gamma Sigma Delta.—Thursday, January 1. President, C. H. Eckles. Secretary, Dr. L. H. Pammel, Iowa State College, Ames, Iowa.

SCIENTIFIC EVENTS

SCIENCE AND INDUSTRY IN NEW ZEALAND

THE Industries Committee of the New Zealand House of Representatives has made the following recommendations for the creation of a Board of Science and Industry:

1. That a Board of Science and Industry be established for the development of national resources.

2. That the board be given an assured finance

for five years; it is recommended that it should receive not less than £5,000 for the first year and £20,000 for each of the four following years.

3. That the board shall be representative of the various sections of science and industry.

4. That the board shall, as one of its chief functions, consider all proposals for specific scientific researches, and shall allot to the proper person or persons the duty of conducting such specific researches as it may approve.

5. That in order to avoid centralization, and in the interest of economy, the board, in the carrying out of investigations, shall wherever possible cooperate with the university, college authorities in the various centers, with a view to making the fullest possible use of their staffs and laboratories; there shall also be set up local advisory boards to inquire into, advise and report upon local problems.

6. That one of the duties of the board shall be to advise primary producers, and those engaged in industrial pursuits, as to the results of scientific investigations affecting or calculated to benefit their industries, including processes for the utilization of waste products.

7. That the board shall have power to establish scholarships and also to award bonuses and prizes, with the object of encouraging scientific and industrial research.

8. That the board shall keep touch with government departments and also with scientific and educational institutions, with a view to cooperation in scientific investigation as well as in furtherance of scientific education and of everything which will tend to foster a greater appreciation of the advantages of science, not only by producers, but by the people at large.

RESEARCH IN THE CERAMIC INDUSTRY

The National Research Council and the American Ceramic Society have established a joint committee for promoting the investigation of scientific problems underlying the ceramic industry, especially by founding a series of research fellowships whose holders shall devote their attention exclusively to these problems. A press statement from the council says:

The ceramic industries, including brick and tile making, and general crockery and glass manufacture as well as ornamental potteries, although among the earliest ones developed by man, have been the last of our great manufacturing industries to reach the status of an applied science. They have been based for centuries on rule-of-thumb methods, trade secrets and individual artistry. As far as their artistic features go science can do little or nothing for them, but in all other ways it can be of great advantage to them.

In sharp contrast to the painfully slow development of these ancient industries is the extraordinarily swift development of such exclusively modern industries as those of synthetic dyes and others entirely based on the discoveries of modern science. The startling success and speed of growth of these are almost entirely the fruit of highly organized scientific research, with methods of scientific control at young stages of the operations. A famous English scientist is authority for the statement that the capital, large as it has been, which the German dye firms have invested in scientific research has been the best-paying investment which the world has ever seen. It is certain that an organized effort to develop the fundamental science of ceramics can have a great influence in advancing the industry.

AWARDS BY THE HENRY DRAPER COMMITTEE OF THE NATIONAL ACADEMY OF SCIENCES

In accordance with the recommendations of the Henry Draper Committee, the following grants and award of medals have been made by the National Academy:

1. \$400 to Dr. S. A. Mitchell, director of the Leander McCormick Observatory, University of Virginia, to complete the purchase of a measuring microscope for use in the photographic determination of stellar parallaxes, on the basis of observations made with the 27-inch refracting telescope. The academy awarded the sum of \$250 from the Draper Fund to Dr. Mitchell in 1916 to apply on the purchase of this instrument. The microscope cost \$650. The proposed grant of \$400 will complete the purchase, in effect making the instrument the property of the academy, and Professor Mitchell will devote an equivalent sum, \$400, to the other needs of his parallax research.

2. \$300 to Dr. Joel Stebbins, professor of astronomy in the University of Illinois, to assist in the further development and application of the photo-electric cell photometer.

3. \$400 to Dr. Frank Schlesinger, director of the Allegheny Observatory, to enable him to test an automatic zenith camera for the determination of terrestrial latitudes with the expectation that the results will be more accurate than any hitherto

obtained by other means. It is proposed that this instrument be mounted at least temporarily at the International Latitude Observatory, Ukiah, California, where the astronomer in charge, Mr. Neubauer, will operate it for a year or two as a labor of love. The grant is needed to install the instrument at Ukiah and to make certain auxiliary apparatus required in its operation.

The Henry Draper Gold Medal has been awarded to Alfred Fowler, F.R.S., professor of astrophysics, Imperial College, South Kensington, London, at the time of the stated meeting in April, 1920, for his researches in celestial and laboratory spectroscopy, which have led to a valuable increase of our knowledge of sunspots, comets and the stars—especially red stars of Secchi's Type III.

ADDRESSES AT THE ST. LOUIS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

As has been noted here the American Association will hold its seventy-second meeting in St. Louis from December 29 to January 3, under the auspices of the educational institutions of that city. With the period of reconstruction now at hand, and with a larger measure than ever before of general appreciation of the extreme importance and value to the country of scientific research, it is expected that this meeting will be one of unusual interest. The address of the retiring President of the Association, Dr. John Merle Coulter, of the University of Chicago, will be on "The Evolution of Botanical Research" and will be delivered at the opening General Session on Monday night, December 29. The addresses of the retiring vice-presidents of the sections, to be delivered throughout the week, are as follows:

Section A.—George D. Birkhoff. "Recent advances in dynamics."

Section B.—Gordon F. Hull. "Some aspects of physics in war and peace."

Section C.—Alexander Smith. "Chemistry as it is taught."

Section D.—Ira N. Hollis. "Industrial problems of the United States."

Section E.—David White. "Geology as taught in the United States."

Section F.—William Patten. "The message of the biologist."

Section G.—Albert F. Blakeslee. "Sexuality in the mucors."

Section H.—Aleš Hrdlička. "The relations of psychology and anthropology."

Section I.—John Barrett. "New after-the-war phases of practical Pan-Americanism."

Section K.—F. S. Lee. "The untilled fields of public health."

Section L.—Stuart A. Courtis. "The part played by heredity and maturity as factors conditioning the effects of training."

Section M.—Henry P. Armsby. "The organization of research."

On Tuesday night, December 30, Dr. Simon Flexner, president of the association, will deliver a popular lecture, complimentary to the members of the association and affiliated societies and to the general public.

MR. FRICK'S BEQUESTS

With the exception of approximately $25,000,000 bequeathed to his family, relatives, friends and employees, the will of Henry C. Frick leaves his estate, believed to be worth approximately $145,000,000, for public, charitable and educational purposes.

Mr. Frick's house and art collection in New York city, which after the termination of Mrs. Frick's life estate are to go to the public, are valued at approximately $50,000,000. An endowment of $15,000,000 is provided to maintain this as "The Frick Collection."

Pittsburgh, where much of Mr. Frick's wealth was acquired, receives a tract of about 151 acres of land in the 14th ward of that city for a park and $2,000,000 in trust to maintain and improve the property.

The residuary estate to be divided into 100 shares valued at about $500,000 each, is left to nineteen institutions.

Princeton University recieves thirty of these shares, or about $15,000,000.

Harvard receives ten shares, or about $5,000,000.

The Massachusetts Institute of Technology receives ten shares, or about $5,000,000.

Educational Fund Commission Pittsburgh, ten shares or about $5,000,000.

Mercy Hospital, Pittsburgh, ten shares, or about $5,000,000.

Thirteen shares are given to Mr Frick's

daughter, Helen, "in unqualified and absolute ownership," but with this suggestion: "It would, nevertheless, be agreeable to me that she should dispose of these amounts, that my general purpose in making these legacies should be accomplished, but this is merely the expression of my wish."

Institutions receiving one share or about $500,000 each are as follows:

Pittsburgh Free Dispensary, Pittsburgh, one share.

Pittsburgh Newsboys' Home, one share.

Western Pennsylvania Hospital, Pittsburgh, one share.

Central Young Women's Christian Association, Pittsburgh, one share.

Uniontown Hospital, in Fayette county, Pa., one share.

Cottage State Hospital, in Connellsville, Pa., one share.

Westmoreland Hospital, in Greensburg, Pa., one share.

Mount Pleasant Memorial Hospital, of Mount Pleasant, Westmoreland County, Pa., one share.

Braddock General Hospital, of Allegheny county, Pa., one share.

Homestead Hospital, of Homestead, Pa., one share.

Children's Hospital, Pittsburgh, One share.

Allegheny General Hospital, Pittsburgh, one share.

Home for the Friendless, Pittsburgh, one share.

Kingsley Home Association, Pittsburgh, one share.

SCIENTIFIC NOTES AND NEWS

Dr. Richard M. Pearce, professor of research medicine in the University of Pennsylvania under the John Herr Musser Foundation, has accepted the position of director of the newly established division of medical education of the Rockefeller Foundation. Dr. Pearce has sailed for Europe to carry out work in the interest of the foundation.

Dr. E. A. Peterson, of Cleveland, Ohio, has been appointed director of the health service department recently created by the American Red Cross to administer its peace-time activities in the health field. Dr. Peterson served during 1918–1919 as major with the American Red Cross commission on tuberculosis to Italy and had charge of the department of school hygiene. For the previous eight years he had been the director of the Department of School Health in Cleveland, Ohio. He has taken up the work and is located at National Headquarters, American Red Cross, Washington, D. C.

Dr P. G. Agnew has resigned as physicist at the Bureau of Standards to become secretary of the American Engineering Standards Committee, with headquarters in the Engineering Building, 29 West 29th Street, New York.

The National Academy of Sciences has awarded its medal for eminence in the application of science to the public welfare to Mr. Herbert C. Hoover for his applications of science in the conservation, selection and distribution of food. The medal will be conferred at the April meeting of the academy.

William Orpen, will paint a presentation portrait of Sir Clifford Allbutt, president of the British Medical Association, and a mezzotint engraving of the portrait will be executed by Mr. H. Macbeth-Reaburn.

The annual address of the Entomological Society of America, at its St. Louis meeting, will be given by Dr. J. W. Holland, director of the Carnegie Institute, on the evening of December 30, the subject being "The evolution of entomological science in North America."

Professor T. L. Hankinson, of the Eastern Illinois State Normal School, has accepted the position of ichthyologist at the Roosevelt Wild Life Forest Experiment Station, at the New York State College of Forestry at Syracuse. This station was established last May by the legislature of New York as a Wild Life Memorial to Theodore Roosevelt. Professor Hankinson will begin his duties at Syracuse on January 1. During the past five summers he has been working for the college on state fish surveys, in cooperation with Dr. Charles C.

Adams, director of the station, on Oneida Lake, and in the Palisades Interstate Park. The surveys, which in the past have been conducted by the department of forest zoology, have been taken over by the Roosevelt Wild Life Station and will be conducted in the main under its auspices.

DR. MABEL L. ROE, who resigned in July as assistant plant pathologist in the Kentucky Agricultural Experiment Station, has recently accepted an appointment as seed analyst in the Dickinson Seed Company, Chicago.

MR. F. W. GLADING, of the Bureau of Standards, has resigned to become industrial engineer for the Baldwin Locomotive Works, at Philadelphia, Pennsylvania.

THE annual dinner of the New York Academy of Sciences and its affiliated societies will be held at seven in the evening, Monday, December 15, 1919, at the Delta Kappa Epsilon Club, 30 West 44th Street. The dinner will be followed by the annual meeting of the academy, to receive reports and elect officers and fellows for 1920. The presidential address will be delivered by Dr. Ernest Ellsworth Smith, on "Applied science and the war." After the president's address there will be given two illustrated talks, as follows: Professor Douglas W. Johnson, on "A geographer at the front and at the Peace Conference," and Professor Henry E. Crampton, on "Tahiti and the South Seas."

AT a meeting held on November 25 in the main auditorium of the New National Museum, Washington, D. C., Professor Irving Fisher, of Yale University, addressed members of the Scientific-Technical Section of the Federal Employees Union and their friends on "The purchasing power of salaries." Professor Fisher elaborated his theory of a stabilized dollar, claiming that an invariable unit of value is of even greater importance than invariable units of other quantities, such as length, weight, etc. The section voted to appoint a committee for a study of the proposal with instructions to report back a resolution granting or withholding endorsement according to the findings of the committee.

IT is announced that unavoidable circumstances necessitate a change in the meeting place of The Federation of American Societies for Experimental Biology. The meeting will be held at Cincinnati, Ohio, December 29, 30 and 31, instead of at Toronto.

MRS. MARY CLARK THOMPSON has presented to the National Academy of Sciences a fund amounting to $10,000, the income of which is to be applied to a gold medal of appropriate design, to be awarded annually by the academy for the most important services to geology and paleontology. The medal is to be known as the Mary Clark Thompson Gold Medal. Mrs. Thompson previously gave an additional $1,000 for the preliminary expenses of dies.

A UNITED STATES Civil Service examination for superintendent in the Bureau of Fisheries will be held on December 30, 1919. A vacancy at the Key West, Florida, Biological Station of the Bureau of Fisheries, at $1,800 a year and vacancies in positions requiring similar qualifications, will be filled from this examination.

UNIVERSITY AND EDUCATIONAL NEWS

DR. DAVID P. BARROWS, professor of education and later of political science in the University of California, at one time director of education for the Philippine Islands and author of works on the islands, has been elected president of the University of California, to succeed Dr. Benjamin Ide Wheeler.

DR. HORACE G. BYERS, formerly of the University of Washington, who was recently appointed chemist in charge of soil investigations in the Bureau of Soils, has accepted the position of head of the department of chemistry at Cooper Union Institute, New York City.

DR. WALTER H. EDDY, who during the war was a major in the Sanitary Corps and served first as assistant director and later as director of the food and nutrition department of the A. E. F., has been appointed a member of the faculty of practical arts of Teachers College, Columbia University, in charge of physiological chemistry.

DR. ERNEST WILLIAM GOODPASTURE has been appointed assistant professor of pathology at the Harvard Medical School.

MR. R. S. TROUP, assistant inspector-general of forests, India, has been elected professor of forestry at Oxford.

AT the University of Lyons, Dr. Mouriquand has been appointed professor of general pathology and therapeutics in place of Professor Lesieur, deceased, and Dr. Policard has been appointed professor of general anatomy and histology in place of Professor Renaut, who has retired from active service.

DISCUSSION AND CORRESPONDENCE

AN UNUSUAL FORM OF RAINBOW

THE following is an account of a rainbow which, although probably simple enough in theory, was entirely new to the writer and seems to be worthy of record. The refracting spheres were neither falling raindrops nor drops suspended in air. They were drops resting on the surface of a lake but kept from breaking through the lake surface by a surface tension effect. They probably resulted from a fog which had hung over the lake during the night and persisted longer than usual after sunrise. The morning was unusually calm, and no ripples had yet appeared on the lake. The floating drops gave the surface an appearance like that caused by a scum, but close examination showed the individual drops quite distinctly and also showed that the light of the bow undoubtedly came from them, for part of the bow came quite close to the observer.

The bow was seen about nine o'clock according to the daylight-saving bill, or eight by the usual local railroad time. Its appearance was about as shown in the accompanying figure. *AB* is the western shore-line of the lake, about 200 yards away. The bow was complete except in the following particulars: the part near *S* was hidden by the shadow of the observer and that of the boat in which he sat; and the part *PRQ* was inverted, like a reflection of what should have been the crest, the part near *R* being somewhat less bright than the rest. The ends of this inverted portion seemed to meet the ends of the larger arc at the shore-line, but there is no reason why such an accidental line should determine the intersection of the two

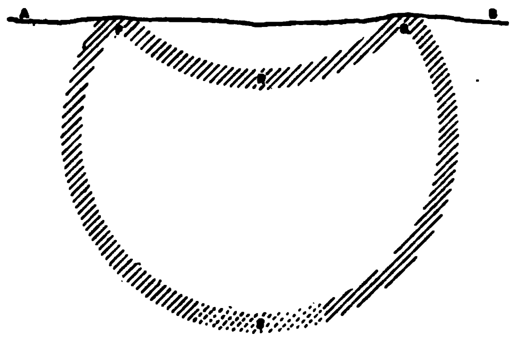

FIG. 1.

branches. Probably they should meet at the horizon. Owing to the closeness of the observer's eye to the water-level, and the distance of the shore-line, the latter would differ in angular position very slightly from the true horizon. Though the bow was very brilliant, no trace of a second bow was visible.

The obvious explanation of the inverted portion is that it is formed by reflection in the lake surface, either directly before or directly after the light passes through the drop. If the light enters the top of the drop and is afterward reflected from the lake-surface, the reflected ray will clear the drop if the elevation of the sun is greater than 21°.6. If it is first reflected from the lake and then enters the drop at the angle of incidence proper to give rise to minimum deviation, the sun's elevation must be less than 20°.4 in order for the incident ray to clear the drop. These figures are calculated on the assumptions that the drop is spherical, that it rests on the surface, and that the angle of the bow is that given by the elementary rainbow theory.

H. M. REESE

UNIVERSITY OF MISSOURI

A SIMPLE DEVICE FOR ILLUSTRATING OSMOSIS

THE difficulty of preparing a "leak-proof" apparatus to demonstrate osmosis by the use of parchment and thistle tube, led me, last

year, to experiment with other animal membranes. As a result I found that the method outlined below proved uniformly satisfactory.

The skin of a freshly killed or of a preserved frog was cut at the junction of leg and trunk. This cut, entirely encircling the leg, permitted the skin of the leg to be peeled off precisely as a glove is removed from the hand. At the knee joint it was necessary to proceed carefully to avoid tearing the skin. Having pulled the skin off as far as the foot, the bones and sinews were cut. The result was a leg-shaped sac, open at the top, containing the bones of the foot at its lower end, and entirely free from perforations. The sac was pulled over the end of a glass tube about twelve inches long, and securely fastened by several turns of strong thread. A strong solution of dextrose was poured into the open end of the tube, and the tube shaken until the liquid passed, drop by drop, down into the sac. This process was continued until the liquid stood about an inch high in the tube. The apparatus was supported in such a way that the sac of skin was completely immersed in a tumbler of water. The level of the liquid was recorded by putting a small label on the tube, and the apparatus was ready for demonstration.

The apparatus and procedure described above have the following advantages over any other method that I have seen:

1. *Simplicity.*—Parts are to be found in any biological laboratory. Entire apparatus can be set up in fifteen minutes.

2. *Reliability.*—It is a very simple matter to secure a water-tight junction of the sac and tube by taking several turns of thread and tying the sac tightly to the tube.

3. *Rapidity of Action.*—Since there is a large surface exposed to osmotic action, the rise of the liquid in the tube is rapid. It is not uncommon to note a rise of one centimeter in twenty minutes. This is a valuable point, for it makes possible the recording of data and results in the same laboratory period. A narrow label may be fastened to the tube to mark the level of the liquid at the beginning of the hour. The data are given the pupil, a sketch of the apparatus is made, and by that time the liquid has risen enough to make possible the recording of the new level and the drawing of conclusions. After the contents of the tumbler have been tested with Fehling's solution, pure water may be substituted, and the experiment repeated.

ELBERT C. COLE
HARTFORD PUBLIC HIGH SCHOOL,
HARTFORD, CONN.

WHY NOT GOVERNMENT-MAINTAINED FELLOWSHIPS?

IN recent number of SCIENCE,[1] Mr. E. W. Nelson has called attention to the many opportunities that exist in Washington for research in connection with the various government bureaus. To the end that these opportunities may be more widely appreciated he suggests a closer cooperation between the universities and these bureaus and he suggests that universities might find it possible to maintain fellowships which would permit their holders to work at Washington.

That such opportunities exist is undeniable and there are doubtless a very large number of workers who would be extremely glad to take advantage of them, but that any university will be able to establish even a single fellowship of this type is almost too much to hope for. The number of fellowships of even the ordinary character is still far too few. However, there is another angle from which the matter may be approached.

Why should not the federal government itself maintain a group of such fellowships? The presence in Washington of the Congressional Library, the National Museum and the various government bureaus has at times been used as an argument in favor of the establishment there of a National University. Whether such a university should be established is perhaps debatable and whether if it were established it could effectively utilize these special opportunities is more so. In fact it probably could not. But in the absence of such an institution, or perhaps even in addition to it,

[1] Nelson, E. W., "Cooperation between Zoological Laboratories and the Government Bureaus," SCIENCE, XLIX., 409, 1919.

these splendid opportunities might well be made available for the holders of such fellowships as I have suggested.

These fellowships should not be restricted to the purely scientific branches. What better place than Washington for historical research? Where else than in the Department of Labor with such a division as the Children's Bureau could certain social problems be studied to better advantage? Yet it is probable that the majority of such fellowships would be in connection with the scientific activities of the government. For that reason it is from our national scientific societies that the initial impulse for a movement leading to the establishment of such an institution must come.

G. F. Ferris

SPECIAL ARTICLES

THE TERM "INVERSION"

The diversity among the phenomena which are referred to by the term "inversion" is so great that at present the word has lost any precise meaning which it may have had in the past. The organic chemist uses it when discussing the behavior of the allotropic forms of a substance and also when alluding to that well-known single-phase phenomenon, the inversion of cane sugar; while the inorganic chemist generously uses it to denote, in addition to the meanings already referred to, such a phenomenon as an incongruent melting. The writer is not an organic chemist and therefore does not wish to criticize the terminology used by the organic chemists, but feels in duty bound to protest against the present use of the term "inversion" by most inorganic chemists.

When an inorganic chemist hears the term "inversion" used, he invariably associates it with phenomena like the change of rhombic to monoclinic sulfur[1] or phenomena like the thermal dehydration of sodium sulfate decahydrate.[2] The first use of the term is, I think, a very satisfactory one, but for the second type of phenomena a different term should be employed, since otherwise there can not but result an overlooking of the important temperature interval which characterizes this type of "inversion" in systems of three or more components. The term "transition," now used synonymously with "inversion," could well be confined to phenomena of the second class mentioned above.

The distinctive feature about an inversion such as that of rhombic to monoclinic sulfur is the fact that the inversion temperature is a fixed point[3] at constant pressure regardless of the complexity of the system, provided no solid solutions are formed, whereas in the case of the transition of sodium sulfate decahydrate to the anhydrous salt the transition temperature is dependent, in addition, upon the composition of the whole system. Thus both hydrated and anhydrous salt can coexist in the presence of suitable liquids over a wide range of temperatures. The change of transition temperature by the addition of a third component is not an isolated phenomenon but rather an example of one of the types met with most frequently in phase rule studies of complex systems.

On the theoretical side Bancroft[4] has pointed out as a corollary of the theorem of Van Alkemade[5] that in ternary systems at constant pressure involving no solid solution the temperatures at which two solid phases can coexist in the presence of a suitable liquid will rise as the composition of the liquid approaches the side line, *i. e.*, will be a maximum in the binary system. In other words, in a system such as sodium sulfate: water: sulfuric acid, the temperatures at which the solid phases, sodium sulfate and sodium sulfate decahydrate, can coexist will rise as the liquid becomes less acid and be a maximum when the solution contains no free acid.

With this corollary in mind, the effect of

[1] Findlay, "Phase Rule," page 34 (1908).

[2] *Ibid.*, p. 138.

[3] The variable inversion temperature of cristobalite (SiO_2) found by C. N. Fenner, *Am. J. Sci.*, 36, 331 (1913), is a phenomenon of unstable equilibrium and is hence excluded from this discussion. discussion.

[4] "The Phase Rule," W. D. Bancroft, p. 149 (1897).

[5] *Z. physik. Chem.*, 12, 371 (1893).

adding a component to the systems under discussion may be deduced. In the first case suppose we had both rhombic and monoclinic sulfur coexisting, and suppose, keeping the temperature and pressure constant, we added another component. The total quantity of crystalline sulfur would probably be changed but the crystalline sulfur remaining (if any) would consist of crystals of both the rhombic and monoclinic forms. In the second case suppose we had a saturated solution of sodium sulfate and sodium sulfate decahydrate and, again keeping the temperature and pressure fixed, we added a third component. The sodium sulfate decahydrate would promptly disappear and only a saturated solution of the anhydrous salt, together with anhydrous salt, would be left. This will probably appear clearer after a discussion of the diagram given in Fig. 1.

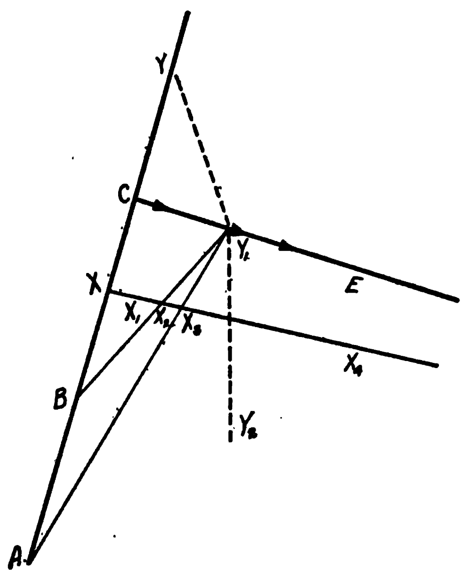

FIG. 1.

Let B in Fig. 1 represent the composition, on one of the side lines of a three-component triangular diagram, of a hydrated salt, and A the composition of the anhydrous form. CE represents the boundary line between the fields of A and B and the temperature falls from C to E as shown by the arrow. Now suppose we take a saturated solution of B in contact with crystals of B, with total composition represented by X and with the composition of the solution represented by Y. The isotherms (saturated solutions of A and B) on the concentration diagram are shown by the lines running from Y to Y_1 to Y_2. If now to X we add the third component the total composition will vary along XX_4. While the total composition varies from X to X_2 the hydrated salt will persist, and while the total composition varies from X_2 to X_3 both salts and the solution Y_1 will be obtained, but when the composition passes X_3 only the anhydrous salt and a solution will be obtained.[6]

Enough has been given, I think, to demonstrate the essential differences in the character of the phenomena under discussion and I would suggest[7] that the term *inversion* be restricted to phenomena like the change of rhombic to monoclinic sulfur, and the term *transition* to phenomena similar in type to the dehydration of sodium sulfate decahydrate, and that in cases in which the composition of all the phases concerned may be represented by simple chemical formulas, the word *dissociation* be employed.

In conclusion I should like to draw attention to a distinction made by Findley[8] between transitions in the solid state and melting point phenomena. He states:

> The transition point, however, differs in so far from a point of fusion, that while it is possible to supercool a liquid, no definite case is known where the solid has been heated above the triple point without passing into the liquid state. Transformation, therefore, is suspended only on one side of the melting point. In the case of two solid phases, however, the transition point can be overstepped in both directions, so that each phase can be obtained in the metastable condition.

This has been interpreted by many to mean that a crystalline substance can not exist even

[6] See Roozeboom, "Die Heterogenen Gleichgewichte," III., part 1, page 190.

[7] Writers like Findlay and W. C. McC. Lewis use the words "transition," "inversion," and "transformation" synonymously, while Bancroft in denoting such phenomena uses the word "inversion" almost exclusively.

[8] "The Phase Rule," p. 37.

momentarily at temperatures above its melting point. Such an interpretation is untrue since this phenomenon has been observed by several investigators[9] with materials such as the minerals quartz and albite, which, while in the process of melting, may exist for some hours at temperatures above their true melting points. Correctly interpreted, Findlay's distinction holds good for cases of true metastable equilibrium, in which no change of phase is in progress, and which are the cases he evidently had in mind.

J. B. Ferguson

Geophysical Laboratory,
Carnegie Institution of Washington,
September, 1919

[9] A. L. Day and E. T. Allen, "The Isomorphism and Thermal Properties of the Feldspars," Publication No. 31 (1905) Carnegie Institution of Washington. J. B. Ferguson and H. E. Merwin, *Am. J. Sci.*, 46, 417 (1918).

ORGANIZATION OF THE AMERICAN METEOROLOGICAL SOCIETY

[Objects: The advancement and diffusion of the knowledge of meteorology and climatology; and the broadening of their applications in public health, agriculture, engineering, aeronautics, industry and commerce.]

Since the publication of the original announcement in Science, August 22, 1919, pp. 180–181, several thousand circulars have been distributed among prospective members. Up to December 1, 470 had indicated their desire to join the society when organized. Roughly, the percentage make-up of these is as follows:

1. Weather Bureau	37
2. Cooperative observers of the Weather Bureau	6
3. Army, Navy and other government people professionally interested in meteorology.	8
4. Business men, farmers, engineers and others professionally interested in meteorology	8
5. Teachers and students	16
6. Canada	2
7. Latin America	3
8. Amateur meteorologists (not classed above) includes those formerly engaged in meteorological work	20
Total	100

Of the whole number 40 per cent. are professional meteorologists. Many have urged strongly that the practical applications of meteorology be emphasized and that special efforts be made to interest engineers, business men, shippers, farmers, fruit growers, aviators and others whose work is closely dependent on the weather. Those who study merely for its scientific interest will have much to gain from association with those who apply meteorology in the conduct of their business. Two leading views expressed concerning the type of organization are:

(1) That the society should be popular in nature in order to get as many as possible interested in the scientific aspects and applications of meteorology and climatology, and in this way to advance the science by united effort and funds to promote research, and (2) that the society should be strictly scientific, and have rigid qualifications for membership, so that the professional meteorologists can by close personal contact cooperate in research to the best advantage. These two views may not be incompatible if the society when organized welcomes as a member any one who is interested in the aims of the society, and elects from among the members, fellows, as a recognition of eminence in meteorology or climatology. It is generally agreed that all members and fellows should have the same privileges and pay the same dues. The council of the society would, naturally, be composed almost of fellows. Thus, the affairs of the society would be directed by its scientists, with the close backing of a large body of interested members.

Dues must be sufficient to pay current expenses of issuing a periodical leaflet of news, notes, queries, etc., but they must not be burdensome for the large group of underpaid government employees and teachers who are interested. If more than 500 members are procured, dues of $1 per year would probably be sufficient. Much has been said in favor of an endowment fund, and, as some have suggested, also library, instrument, scholarship, and building funds. To procure endowment, the society will probably be incoporated

and provisions made for contributing, sustaining and patron memberships.

A preliminary meeting to discuss organization plans and to nominate officers of the American Meteorological Society will be held at the close of the meteorological program of the Philosophical Society of Washington, Saturday evening, December 20. The meeting for organization will take place at Soldan Hill School, St. Louis, December 29, at 2 P.M., and sessions for the presentation of papers will be held December 30 and 31. Joint sessions are being arranged with the American Physical Society and the Association of American Geographers for December 31 or January 1. Plans are being made for a meeting in New York on January 3.

A tentative constitution and by-laws, conforming as far as possible with the numerous and diverse suggestions received, is being drafted, and will be printed about December 10, along with the programs and abstracts of papers to be presented at the St. Louis and New York meetings. These, with details as to hotel accommodations in St. Louis, will be mailed up to December 20 to those who have indicated their desire to join the society.

CHARLES F. BROOKS

WEATHER BUREAU,
WASHINGTON, D. C.

THE AMERICAN CHEMICAL SOCIETY. V

FERTILIZER DIVISION

F. B. Carpenter, *Chairman*

H. C. Moore, *Secretary*

Injurious effects of borax in fertilizers on crops: B. W. KILGORE.

The conservation of nitrate of soda in the chamber process for the manufacture of sulfuric acid: ANDREW M. FAIRLIE. In connection with the prevalent protest against the high cost of food, means for conserving nitrate of soda in the manufacture of sulfuric acid has a two-fold interest: (1) The lowest possible consumption of nitrate of soda in the manufacture of sulfuric acid means low cost for producing the acid, and, as sulfuric acid is a principal item in the cost of making acid phosphate, cheaper sulfuric acid should result in cheaper phosphate, and cheaper phosphate, in cheaper food. (2) Nitrate of soda is itself an important ingredient of fertilizer, and any decrease in the consumation of nitrate for making acid should react in favor of a decreased demand, and so of a lower price, for nitrate of soda. The various methods of introducing nitrogen compounds into the acid-making process are reviewed, and the methods in common use for controlling the chamber process are briefly described. Attention is directed to the gradual extension of the analytical method for chamber-process control, and to the improved results attained where this method has been adopted. The Gay-Lussac tower, as a means of recovering the nitrogen compounds, is not yet an ideal, nor yet an efficient, piece of apparatus, and the need exists for either (1) an improved type of Gay-Lussac tower; (2) an auxiliary to the Gay-Lussac tower; or (3) a substitute for that tower, capable of effecting a higher percentage of niter recovery.

Check meal work of the Society of Cotton Products Analysts (in particular reference to the moisture and ammonia determinations: F. N. SMALLEY.

The Deroode-perchloric acid method for determining potash: T. E. KEITT.

A rapid and accurate method for determining nitrogen in nitrate of soda by the Devarda method, and the use of the Davission scrubber bulb: C. A. BUTT. A rapid and reliable method for determining nitrogen in nitrate of soda, suitable for routine analysis, consists of reduction of the nitric nitrogen to ammonia by the use of 3 grams Devarda's Alloy, 20 mesh, in a solution of 300 c.c. volume containing 3–5 c.c. sodium hydroxide 45° Be. The distillation of the ammonia is carried out synchronously with the reduction, using the regular Kjeldahl apparatus fitted with the Davisson type of scrubber, which prevents alkali mist reaching the receiving flask. An aliquot of the nitrate solution, corresponding to .8517 grams sample, is used and the ammonia collected in $N/2H_2SO_4$. Titrations are made in the usual way, using methyl red indicator. Results are reported showing accuracy of method.

The rapid and accurate determination of nitrate, as ammonia, in nitrate of soda by a modification of the Kjeldahl-Gunning method vs. the deceptive west coast or refraction method. Correct and rapid application of the modified Kjeldahl-Gunning method to mixed fertilizers containing nitrate: H. C. MOORE. The author compares the various methods in common use for analysis of nitrate of soda,

referring to the relative convenience of these methods for fertilizer chemists. Also points out again that the West Coast method is deceptive and recommends that it be eliminated from contracts governing transfers of commercial nitrate of soda. Also shows development of a modification of the Kjeldahl-Gunning (sulfuric-salicylic) method for the rapid and accurate determination of nitrate, as ammonia, also indicates errors in this method as sometimes used. Also shows correct application of the method to mixed fertilizer containing nitrate.

The caking of sulphate of ammonia: C. G. Atwater and Dr. J. F. W. Schultz. Sulphate of ammonia, even when dried and screened to fit it for fertilizer use by itself as a top dressing, has shown a tendency to cake in certain cases. Examination of the material that had given trouble finally indicated in this case that the trouble was due to the presence of salts of pyridine bases which are deposited with the salt in the saturator. These impurities give the salt a slightly sticky nature; cause absorption of water and caking. By passing dry ammonia gas through the sulphate to neutralization, the pyridine was set free and the objectionable characteristics removed.

The caking of sulfate of ammonia and acid phosphate mixtures: C. G. Atwater and J. F. W. Schnultz.

The American potash industry: R. O. E. Davis. Domestic production of potash grew from 1,000 tons in 1915 to 9,000 in 1916, 32,000 in 1917, and 55,000 in 1918. At the close of 1918 there was a potash-producing capacity in this country of approximately 100,000 tons per annum. The sources of potash are widespread, covering about sixteen states in various sections of the Union. The main production has come from Nebraska and California. Fourteen cement plants have installed methods of collecting potash from flue dust. Two blast furnaces have similar methods in operation. Five molasses distilleries are recovering potash from their wastes. A number of beet sugar refineries recovered small amounts of potash. The Green sands of New Jersey are a source of potash for two plants. One plant is utilizing Georgia shale as a source of potash. One plant at Marysvale, Utah, is utilizing alunite, and kelp formed the basis of operation for four large companies on the Pacific coast. Other minor sources exist, such as wood ashes, wool washings, and the brines of the great Salt Lake basin. The best prospects for the development of a permanent industry in competition with foreign potash appears to be from the gradual solving of technical details of processes where potash can be obtained in localities near consumption centers and in the development of by-products. Western producers must meet the handicap of high freight rates to eastern markets, although the development of by-products and improved methods may overcome this handicap.

The relative availability of nitrate nitrogen and commercial organic nitrogen—field and cylinder experiments: A. W. Blair. For more than 20 years, the New Jersey Experiment Station has been studying by means of field and cylinder experiments, the relative availability of nitrate nitrogen from organic sources. The work has been conducted on two types of loam soil and also on a loam with varying admixtures of coarse white sand to represent soils varying in texture. For all of these soils, except those containing 80 per cent. or more of sand, the nitrates have stood first in yield of dry matter and percentage of nitrogen recovered in the crop. Under the most favorable conditions, only a little over 60 per cent. of the applied nitrogen can be recovered in the crop. Under less favorable conditions, the percentage recovery is much lower, often amounting to only one third of the amount applied. The average recovery of nitrate nitrogen in the field experiments was 37 per cent. and of organic nitrogen 26½ per cent. It is suggested that the reason for the larger return from nitrate nitrogen than from organic nitrogen may be found in the immediate availability of the former. The plant is thus given a good start and on account of the rapid growth which it makes, it is able to utilize the nitrogen more fully than the plant which must wait for a supply of available nitrogen, until the organic matter has gone through the process of decomposition.

Charles L. Parsons,
Secretary

(*To be continued*)

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CONTENTS

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AGRICULTURAL BOTANY IN SECONDARY EDUCATION[1]

THE advance of physical science during the past century, and the application of the results gained therein to industry, and especially to the means of transportation and intercommunication, have made desirable and available, areas of the earth's surface hitherto unsought or inaccessible. Because of the development of mechanical agencies through science, the present age, more than any other, is characterized as an age of economic exploitation. The freedom and mystery of the older earth are departing, and soon will be gone forever. Never again will there be another Odyssey. The spirit of the new Age of Steel is over us—the spirit of exploitative and capitalized industry, that is reaching with magnificent ease out to the remotest confines of the planet, uncovering all the secret places, and blazing plain bare trails athwart the earth, straight to the very capitals of the ancient fairylands of geography. What mystery is there left in Peking or Timbuktu, in Samarkand or Candahar? To commerce, the names of the nations are but words in a game; their habitations but the squares of red and black on the chess board upon which the game is played; their remoteness a mere relativity of cost of communication.

In a sense that is far from Emerson's this spirit is embodied in the words:

> Far or forgot to me is near,
> Shadow and sunlight are the same,
> The hidden gods to me appear,
> And one to me are shame and fame.

The first exploitation of new territories has always been made by adventurers driven by the primitive Wanderlust; by men impatient of sitting in sodden security, but ever eager

[1] Address before the Iota Chapter, Sigma Xi, University of Kansas.

to voyage on and try the hazard of new fortunes. It is to men like these that we owe the opening of new regions to settlement. In them through all ages has spoken the soul of Odysseus:

> Push off, and sitting well in order, smite
> The sounding furrows, for my purpose holds
> So sail beyond the sunset and the baths
> Of all the western stars, until I die.

The world, however, has passed through this epoch. No new lands lie under the sun waiting discovery, for the earth's surface, in all its essentials is roughly known. The home of El Dorado, the Fountain of Perpetual Youth, the Seven Cities of Cibola, Bagdad, the Land of Ophir, Cipangu, Lhassa, the country of Prester John and the city of the Great Khan, like the Poles of the Earth and the "Old Moon Mountains African,"—all these have faded out of the romanticism of twilight obscurity into the daylight monotony of the commonplace. Magical names that once lured mankind, have vanished like the Wagnerian gods, over some rainbow bridge into the Valhalla of their own romance.

We will do well to pause for a moment to contrast the modern movement that is enmeshing the earth in a net of industrial enterprises, with the spirit of the Age of Discovery just closing, that we may better orient educational work with respect to future necessities and present demands. Especially is this required of the sciences, upon the development of which industry depends. In the field of biology, the extent to which botany becomes an effective factor in modern education, depends very largely at the present time, whether we will it so or not, upon the degree to which it can be brought to efficiently cooperate in practical affairs.

For our greater and our lesser happiness, the boyhood of the human race is past. We are growing up socially and economically, and the inevitable outcome is going to be the mastery of the globe by means and for ends that are scientifically economic, and in the long run unquestionably altruistic. If this development means the elimination of mystery and glamor so far as the earth's surface is concerned, it yet remains for biologists to exploit the deeper mystery and the more thrilling story of life itself in all its protean forms upon that surface. If this transformation means the elimination of the poetry of the naïve childhood of the race, we may yet, perchance, find a higher poetry in the grander rhythm of a developing social life and a more harmonious evolution of wider racial ideals. Such at least are the deeper reflections of science—science that has come both to destroy and to fulfill.

In no other field of industry is the scientific age working greater changes than in agriculture. The cldest, the most primitive and the most necessary of occupations, agriculture, has been, until the last centruy, the field most neglected by science. In the older countries of Europe, a sharp social stratification, involving contempt for manual labor among the so-called upper classes, has been one of the retarding factors in agricultural development. Agriculture there is still largely the occupation of the peasant, and for the most part, the university and the peasant never meet. While this is rather a bald and radical statement of the situation, it holds good in its general outlines for most of the European states operating under the aristocratic systems of the past, while in the rest, the prejudice referred to still survives as a social memory.

In our own country, settled at the outset by immigrants who chiefly came from a body of land-loving and free-holding people, social prejudice toward agriculture is a comparatively minor matter, economically speaking. Strange to say, however, the very favoring conditions of our environment have hindered agricultural development along scientific lines. Our land was originally boundless and seemingly inexhaustible. It was impossible not to make a living on a farm, and anybody could become the possessor of one. There were no agricultural economic problems to solve, beyond the question of markets for the surplusage of the farm. What wonder that agriculture awakened scant interest in the scientific world. If the soil began to yield less as the years went by, under a wasteful,

extravagant one-crop system, there was always more cheap land farther west, to which emigration could proceed. Furthermore, although social prejudice was largely eliminated in America, the utter ease and simplicity with which a living could be gotten out of the land on the one hand, and the relatively small cash returns and the severe discomforts of farm life on the other, have correspondingly continually operated to tempt the more ambitious minds away from the farm. Something that anybody can do, does not appeal to the more enterprising and gifted individuals. Not only that, but the youth who ventured his fortunes in business or the professions, embarked the more confidently perhaps, because of the feeling that if he failed elsewhere, he could still always go back to the farm as a last resort and make his living. Conditions, however, have radically changed. Not only is agriculture no longer the simple occupation it once was, but the greater portion of the best land is now under the plow. No new soil resources remain to be drawn upon, except in the dry plains area, and the arid regions of the west, upon the development of which nature has imposed severe limitations which can never be entirely removed. The torrent to the west has dwindled to a trickling stream, and from now on we must bend our energies toward the building up of the lands that have already been exploited in a pioneer way.

The population of the country is now under present methods overtaxing the cultivated land for its support. It has been said that we are consuming thirteen months of wheat every twelve months. The ratio of those engaged in agricultural pursuits, to those engaged in all other occupations, in the decades since 1870 is as follows:

TABLE I

Year	Ratio of Those Engaged in Agriculture to Those in Other Occupations
1870	1: 2.10
1880	1: 2.24
1890	1: 2.65
1900	1: 2.80
1910	1: 3.01

In other words, whereas in 1870 one person engaged in agriculture represented two persons engaged in other occupations, in 1910 there were three persons in other occupations to one in agriculture.

In respect to percentage of the population, the following relationship is found to exist.

TABLE II

Year	Per Cent. of Total Population Engaged in Agriculture
1870	15.43
1880	15.38
1890	13.68
1900	13.66
1910	13.76

In the forty-year period up to 1910, the percentage of the total population engaged in agricultural pursuits fell off 1.67 per cent. while the percentage relation of the ratio of the number engaged in agriculture to those in the other classified occupations, meaning thereby largely, effective young and adult males, has widened by 30 per cent. since 1870.

If we now turn to the rate of production in agriculture for the same period, dividing the United States into more or less homogeneous districts, we find the acre-value of all agricultural products raised in the different crop-growing regions of the country to be as follows:

TABLE III

Region	Year					
	1910	1900	1890	1880	1870	Average
North Atlantic...	$19.03	$11.70	$9.90	$7.85	$12.83	$12.26
Middle Atlantic...	14.06	9.75	9.21	9.99	16.00	11.80
S. Atlantic and Gulf ..	16.17	8.85	8.44	7.82	12.27	10.71
Central.....	11.62	7.09	6.69	7.63	12.46	9.10
North Central	11.35	7.15	7.34	8.64	16.02	10.10
Plains......	8.48	5.56	4.50	5.15	15.27	7.79
Rocky Mountain..	6.56	6.14	6.58	7.98	18.24	9.10
Pacific......	12.75	7.50	6.82	5.78	7.85	8.14
Average..	$12.50	$ 7.97	$7.44	$7.63	$13.87	$ 9.88

From the above table, there appears to be no consistent, consecutive increase in the

acre-value of farm products for any of the regional divisions in the United States during the period in question—something more than a generation. The vertical columns show a remarkable harmony of acre-values over the whole United States for the same census year. This fact, coupled with an entire absence of any uniform upward trend of values for the period, either for the regions individually, or for the United States as a whole, clearly demonstrates that the acre-values of American farm products for the past generation have been entirely dependent upon accidental years of good crops or good prices or both.

The situation is still more strikingly set forth when we compare the percentage increase or decrease in improved acreage from one decennial census period to another, with the percentage increase or decrease in the acre-values of agricultural products for the same period, as shown by the following table.

average net increase for the four decennial periods, as shown in the last two columns. Here however, the fact is demonstrated, that in practically every agricultural region in the United States, the average net percentage increase in the improved acreage for the forty-year period, has out-distanced and in most cases greatly outstripped the corresponding percentage increase in acre-value of production upon that acreage. Surveying the figures in more detail, we find that in the most typical agricultural regions of the country—in the South Atlantic and Gulf and in the Central region—the manner in which the percentage increase in acre-value of farm products falls behind the percentage increase in the improved land under cultivation, gives just cause for consideration. When we consider that in the Central region, the states of Arkansas, Illinois, Indiana, Iowa, Kentucky, Missouri, Ohio, Tennessee, and West Virginia, comprising the upper Mississippi drainage basin, certainly pre-eminently the typical agricultural part of America, the average net percentage increase in farm acreage for the entire past generation has outstripped the corresponding net percentage increase in acre-products upon it by 14.15 per cent., it would seem proper for science to give the matter serious consideration and attention. In the Plains region, where improved methods of farming on dry-land areas, and the intro-

TABLE IV

Region	1870–1880 Per Cent. Increase or Decrease		1880–1890 Per Cent. Increase or Decrease		1890–1900 Per Cent. Increase or Decrease		1900–1910 Per Cent. Increase or Decrease		Acreage Av. Net Increase Per Cent.	Acre-Val. of Farm Products
	Acreage	Acre Value of Farm Products	Acreage	Acre Value of Farm Products	Acreage	Acre Value of Farm Products	Acreage	Acre Value of Farm Products	1870–1910	Average Net Inc. Per Cent. 1870–1910
North Atlantic	8.75d	32.91d	18.32d	28.64i	24.25d	10.50d	10.81d	32.52i	15.53d	4.44i
Middle Atlantic	12.32i	28.80d	4.16d	7.48d	2.02d	9.34d	4.76d	27.21i	1.38i	6.14i
South Atlantic and Gulf	17.11i	23.04d	16.88i	22.96i	10.44i	14.55i	8.94i	5.17i	13.34i	2.33i
Central	32.60i	9.21d	10.25i	22.31d	11.11i	16.19i	27.95i	40.63i	20.48i	6.33i
North Central	46.09i	9.57i	19.75i	55.21i	16.91i	23.81i	6.52i	41.15i	22.31i	32.44i
Plains	81.28i	44.49i	57.37i	51.22i	23.85i	38.37i	31.68i	55.17i	48.54i	47.31i
Rocky Mountains	73.97i	40.47i	58.47i	50.87i	35.01i	30.31i	47.20i	66.60i	53.91i	47.06i
Pacific	43.63i	23.43i	23.96i	35.55i	6.36i	14.90i	14.91i	49.94i	22.21i	30.96i
General Average Net Increase									24.71%	22.12%

In the table above, the increase and decrease of both acreage and acre-yield, are placed on a percentage basis, and are therefore comparable each to each. If, therefore, the acre-yield from one decennial period to another had kept step with the acreage yield, the percentages of increase and decrease would be harmonic. This, however, is not the case. There is little or no correspondence between the two. If any harmony existed, it would certainly be shown in the general

duction of better crops, such as alfalfa and the sorghums, and in the Rocky Mountain and Pacific regions, where irrigation is practised and higher-priced crops are grown, the percentage increase in acre-value of the products, equals or surpasses the percentage increase in acreage of the improved land.

Taking the evidence as a whole for the entire country, it appears from the general average at the foot of the last two columns, that in forty years the net increase in food production in the United States ran behind that of the land brought under cultivation by about two and one half per cent. In other words, the people on the farms failed to raise enough more products per acre, as measured by the average selling price, to correspond with the amount of land they were cultivating. That this is partly due to a falling off of agricultural labor is probable; that it is partly due to diminishing fertility from continuous cropping is measurably certain. It is likewise evident that this general situation has been arrived at in spite of the fact that the period in question, covers nearly the whole period of the rise and growth of the state agricultural colleges and experiment stations, and the development of the enormous activities of the United States Department of Agriculture, through all of which agencies, new and better systems of tillage, cropping and rotation, and feeding of farm animals, have been introduced and disseminated, all of which should contribute to operate toward counter-balancing the losses from the other sources.

If the agricultural situation has been thus detailed at some length, it is in order to bring out the vital fact that there is a definite demand upon science, and especially upon that part of science that is capable of dealing scientifically with at least some of the factors underlying plant production, to lend its aid to the relief of a situation that is becoming worse instead of better. This is the matter with which the agricultural colleges have to deal and which bears a vital relation to the teaching of botany.

So far as botany is concerned, the main problem from the educational standpoint is, how can the young people in the public schools receive such a training and discipline as will be of scientific value, and at the same time be of vital economic use in their everyday life.

As a general social question, the problem is, how can this subject which can unquestionably be made of economic value, be so handled as not to destroy its integrity as a part of the teaching of science, and at the same time contribute its maximum help to agriculture. Now our principal business with secondary school pupils is not merely to give botanical discipline in an abstract sense, but to give such students as broad and as scientifically accurate a knowledge as possible of the only plants with which they are ever likely to deal, and from which the world gets its living. About ninety-five per cent. of high-school graduates go no further. Should effort be devoted to giving these immature minds a hasty and inadequate sketch of a botanist's realization of the plant world, or should we rather be contented with giving them that part of botany that will be most useful and necessary in their probable occupations. I think unquestionably the latter. We are certainly not precluded thereby from making botany a subject of disciplinary value. Charles Darwin was not a superficial student of plants, for the reason that he directed his studies to those phenomena which the seed plants alone offer to the unaided eye. After the pupil has thus built up a solid and substantial knowledge of the way in which the higher plants are constructed in their more obvious aspects, and how they perform their work, time should then be devoted to widening this plant horizon, by bringing in the lower groups in succession. But even here it is wise to avoid a strenuous attempt at a scientific discussion of the alternation of generations. The object, at this juncture, should mainly be to give the student an alga concept, a fungus concept, a fern concept and so on, that he need not go through life entirely ignorant of what these lower forms of plant life are, how and where they live, and their economic relation to the earth, especially of course to man.

It is not impossible to make plant evolution the central axis around which to swing a high-school course in botany. High-school pupils can be trained in this sort of discipline, but it usually involves the wooden adherence to a few "types" illustrating a supposed evolutionary series, and imposes severe limitations upon a student's conceptions of plants, no less detrimental in its effect upon his mind than the rigid conceptions of "typical" plants, and the stereotyped leaf and flower forms of the pseudomorphology of the older school. The phylogenetic method of teaching botany to elementary students, is not only objectionable because it deals with plants which are almost throughout entirely unrelated either to their previous experience and observation, or to their future necessities, but because, as ordinarily handled, the data are confined to a comparatively few type plants because of the time restrictions imposed. The result is, that instead of widening his horizon of the plant world, the succession of forms worked upon, serve chiefly as mnemonic beads in a botanical rosary, the telling of which serves to call up memorized facts for examination purposes, chiefly concerning reproduction.

At the present time, the teaching of botany in secondary schools is quite generally morphological in character, a survey of the general morphology and reproduction of the great groups of plants in succession. This is done partly by virtue of tradition, and partly because the subject is most easily handled in that way under average conditions. In too many cases however, this sort of teaching degenerates into a sort of stereotyped routine, revolving around the peculiar relations of the alternating generations in plants—the tragic story of the decline and fall of the gametophyte and the triumphant rise of the sporophyte. This rather extensive and various history has become condensed and standardized for teaching purposes into an orthodox version, to the correct rendition of which a few selected forms of plant life are annually consecrated. Beginning with the microscopic, unicellular forms of green algæ, we proceed, with side excursions into the equally microscopic blue-greens, up through colonies, flat, globular, and in chains and filaments, until we finally get to a real alga that we can plainly see with the 1/6 objective. From here on, the pathway leads finally to where *Fucus vesiculosus* and *Polysiphonia violacea* are waiting to tell their tale of the alternation of generations and heterospory. Once in the clutches of these two ideas, botanical anxiety for the student begins, for he is there to stay.

We are now, however, compelled to divert our attention for a time from green evolution in order to pick our way over the fungi, after which we duly return to our duty of securing the transition in the laboratory from water to land life, whereby there emerges, with dripping rhizoids, a liverwort upon the mud.

The Bryophytes, unfortunately, are still very small plants, and usually do not of their own motion excite undue interest among young people. However, this is not for us to discuss, to be sure, since it becomes our responsibility for the next few weeks, to make the curious and rather minute relations of the gametophyte and sporophyte series in this group the chief object of our ambition. There is many a beginning student who has been led during this period of his life to suppose that botany thinks a great deal of *Marchantia polymorpha*. Bidding farewell at length to the Hepaticæ, we become greatly obliged to the botanical supply company for its fruiting *Sphagnum* and its *Polytrichum commune*, whereby we are enabled to continue the ever-lengthening story of the everlengthening sporophyte and its ever-diminishing spores.

The leafy gametophyte of the Bryophytes has now to roll up its foliar organs and be born again like unto a liverwort, re-emerging before the student as the prothallium of the ferns. We have now at last gotten roots on the sporophyte, and its future is assured, so that we can henceforth proceed to devote our remaining attention to prosecuting our favorite microscopic pursuit of the luckless and reticent gametophyte, as it elusively recedes from form to form, through *Marsilia, Salvinia* and *Pinus Laricio,* until its final recondite

demise in *Lilium Martagon,* and the last "slide" is "drawn."

Is this a caricature? No more so than many such a course is a caricature of reality in the plant world. The question is, does it pay, with the limited time usually available, to sketch hastily through a syncopated genetic series in secondary school work. The primary object in following such a series through, is to get before the student a picture of the upgrowth of the sporophyte form, which is the final stage in morphogenetic evolution in plants, and through the facts in reproduction, throw light upon the evolutionary relationship of the various phyla.

To this end, beginning students who have usually observed little with their eyes, have to be armed at the very outset with the dubious weapon of the compound microscope, and their first weeks in botany are consecutively devoted to an examination and study, almost entirely through the microscope, of organisms that the most favorably disposed among them are hardly prepared to appreciate as plants. From the pedagogical standpoint this is a weak approach. If however, instead of the groups of the Thallophytes, and the succeeding members of the evolutionary series, the seed plants are made from the outset the center of gravity of the teaching, the interest and sympathy of the students is more easily impounded. If this method is followed, it is desirable, instead of beginning with a study of seeds and seedlings and so on, to commence with a complete life-cycle exercise covering the entire life history of the species, from the seed on to maturity and seed reproduction. This can be done by means of a serial succession of plantings made in advance, whereby the student gets at once at a given laboratory period, an immediate present view of all the stages through which the plant has had to pass. Lima beans, for example, handled in this way, will give satisfaction, and, in the final stages, will furnish a complete series in the plant's reproduction, from unfertilized flowers on to well-grown seed pods upon the same plant. All the morphological details of structure of all the different organs may be worked out at once upon such a plant, and many species may be introduced in series in the same manner for comparative study of types of development. The morphology however, it ought to be emphasized, should be accompanied step by step, by experiments in the physiological behavior of the same organs. Osmosis experiments should accompany the study of roots and root-hairs, and not be postponed to some future exercise in physiology Transpiration and photosynthesis experiments should be conducted simultaneously with the study of the leaves as such. Conduction should be studied experimentally, at the same time with the study of the structure of stems. The rate of growth of stems and roots, and of the floral organs before and after fertilization, should be determined while the students are engaged at the same time upon the morphology of those structures.

It is a useful and practical thing, when dealing with the structure of leaves, for example, to take plants in which there is a considerable deposition of reserve food, such as corn, potato, sweet potato, etc.; in warmer regions, taro, sugar cane and banana, and have the pupils determine for the entire plant, the total percentage amount of combustible dry matter, taking the storage regions separately as such. By separately determining the total percentage amount of water, dry matter and ash, the work of the plant as a machine in the manufacture of carbohydrates can be plainly seen. If the area of the leaves is now measured, the number of grams of carbohydrates produced per unit of leaf surface can be calculated, and this in turn can be converted into terms of energy in calories. If such an exercise as this, together with field work in leaf ecology, accompanies the study of palisade cells, stomata and conduction tissues in leaves, the latter will be seen in the light of functioning organs, and not as static structures. There seems to be no disputing the fact that the study of the structure of organs will be vitalized, by experimental work alongside at the same time upon their functions. It is correspondingly useful, for example, while engaged in the study of the structures of reproduction, to have the pupils demon-

strate for themselves, as with such plants as corn, wheat, beans, or the more common prolific weeds, the volume and extent of their reproductive energy, as measured by the number and amount by weight of their seeds. The relative prolificacy of representatives of tested varieties of the same cultivated species, such as soy beans and cow-peas, may be used for a comparative study of the relative expenditure of vegetative and reproductive energy. If plants in flower are accessible, such as can easily be hand-pollinated, such as corn, cotton or tobacco, many of the fruit trees, garden geraniums, etc., the time elapsing between pollination and the first signs of fertilization should be ascertained experimentally. Such experiments as these, combined with field experiments in cross and close fertilization and in the study of the adaptations thereto, vitalize for the pupils the whole study of the structures of reproduction, and of the scientific aspects of the reproductive process.

In fact, throughout the whole elementary botany course, every possible effort should be made to illustrate immediately, structure by function and function by structure, and to bring out the variations in structure which accompany variations in function under different habitat conditions. Students should be led especially to study the biological adaptations of plants to their environment in their own neighborhood. If some study of plant evolution is lost in doing this, the gain will be compensatory, since the pupils will come to realize that plants are vital and very variable biological organisms, with various dynamic activities, and not "typical" static structures, chiefly engaged in reproduction.

In any event, a beginning course in botany should strive to give students some conception of the luxuriance, richness of material, riotous abundance in color and form, and marvellous complexity of structure and adaptation which is the reality of fact in the plant world, instead of leaving him with a conception of pettiness in the materials offered, of triviality in the functions performed, and of dryness and stiff formality in the relationship, of the organisms. One way in which to avoid the sense of pettiness which well-grown students not infrequently experience in being set to work upon the lower and smaller forms of life, is to increase greatly the number of forms and types for general comparative habit-study. In working with algæ for example, a considerable supply of a wide variety of fresh-water forms collected locally, supplemented from a marine supply company, by as large an assemblage of species of the larger marine algæ as can be afforded, coupled with a study of the use of the latter for food, fertilizers, etc., will do more for the student educationally than an intensive study of a few, unfortunately for the most part, species of insignificant size and of lesser economic importance. In the study of the lower forms, *it should be made a general policy throughout,* to secure for habit study a large variety of species of the forms worked with, in order to give the students, to some extent at least, a comparative, conception, a broader mental idea, of the groups taken as a whole.

In the study of the fungi, a secondary school course in botany should consist mainly in a study of plant diseases, with enough experimental work in growing cultures of important pathogenic organisms at least, to teach the student the nature of the invading fungi. That such a course can comprise all the forms necessary to include the various types of fungus morphology and spore reproduction, is sufficiently manifest. A course of this kind should leave the pupil knowing most of the commoner diseases of the ordinary farm, orchard and garden plants, and their means of prevention.

Such a rapid survey of the lower groups of plants, systematic rather than morphological in character, should likewise be followed by a systematic study of the more important orders and families of the seed plants. The work should here be more intensive than with the lower groups, for here is the opportunity to present in orderly sequence, in something of a connected series, the extraordinary array of the economic plants. All of the principal agricultural, forest and garden plants, the wild flowers, the poisonous species, the drug plants, and the weeds of the farm and the wayside, can now be thrown into orderly

sequence, as their representatives are brought into the laboratory for study. No course in botany for high-school students ought to be considered satisfactory, that does not give a tolerably good idea of the relationships of the principal families of the seed plants, of the place of the economic plants among them, and of their geographic and ecological distribution.

Toward the close of the year, and after the systematic work referred to, some simple work in the study of variation, and of the results of selection should be taken up. There is no better way of developing observation in young people, than by setting them to work collecting all the so-called "variations" they can find of a number of species of plants. A little simple work in plotting variation curves is also easily possible with high-school students. A school garden can be made to afford a series of plants to be used in hybridization, and the pupils can readily be taught the necessary technique in plant breeding. Curiosity once aroused as to the outcome of crosses, and interest awakened in the possibility of originating new forms of plants, the high-school teacher will find such a summer occupation for the brightest pupils as may lead to serious and important results. Many a student in a farm neighborhood will be aroused thereby to undertake valuable work in the improvement of staple crops, such as will bring about economic results of value to an entire neighborhood. It is also perfectly easy to convey to pupils of this age a working knowledge of the elementary principles of breeding, sufficient to serve for a considerable range of practical purposes.

We may therefore conclude that a course in agricultural botany for secondary schools should differ from the ordinary academic course in the same subject in the following respects:

First, in the aim of the course, which is the economic advantage of the pupil rather than the professional array of the subject from the standpoint of discipline.

Second, in the means used for botanical instruction, the seed plants being largely employed as teaching material for practical purposes.

Third, in the extensive use of plants of economic value as the means through which to study plant structure and functions.

In the hundreds of cultivated forms of grasses and forage plants, in the multitude of varieties of the grains, in the horde of the vegetables, in the manifold fruit-bearing plants of the orchards and gardens, in the wealth of valuable forest trees, ornamental garden plants and shrubbery, in the array of plants grown for fibers, for drugs, gums, resins, rubber, beverages, condiments, and spices in the parasites, poisonous and noxious plants and weeds, there exists a vast botanic garden of species, varieties and biotypes of plants. wild and cultivated, in which every modification of form, and every biological adaptation of structure to environment is found. There is no type of root, stem, flower, or seed structure, generalized or specialized, that is not to be found among them. There is no mode of securing or preventing cross or close pollination which they do not exhibit. There is no mode of performance of a single physiological function in any type of habitat that they do not display. In this maze and medley of plants cultivated by man, and which carry the initial intrinsic interest of economic value, are limitless opportunities for developing in a beginning course in botany, fresh and interesting types of material for the study of the organs and tissues of plants, their work and their relation to soil and climatic environment. Here is the high school's, and especially the rural high school's opportunity in botany.

In all communities, and especially in rural communities, a course in botany should have three fundamental objects—to stimulate observation, to give such botanical knowledge and training as will be most useful, and to impart culture. Let us briefly consider these three leading motives.

First, as to the matter of observation. Our public school system is overburdened with second-hand learning. Ideas are furnished ready-made in books. The written word becomes a fetish. The child gets most of his

notions of the universe by reading what somebody else has said about it. Everything has to be subordinated to getting large masses of pupils "through the grades." The simplest way to do this is to cause large quantities of ready-made, predigested information to be memorized, recited upon and "passed" in examination. Originality, curiosity, spontaneity, are all effectually stamped out by this process, and the child, who is naturally an investigator to begin with, becomes in the end a mere passive recipient of prescribed orthodox information.

It is the duty of the biological sciences to step into the school room, reawaken this latent curiosity, and fan the sparks of originality into the flame of investigation. Can this best be done by a course in botany that is "scientific" from the adult standpoint, but that is totally lacking in vivid human interest from the point of view of young people. Shall we stimulate observation in eyes already grown accustomed to looking for the world in print, by carrying them still farther away from the domain of sense experience. we must compel young people to realize the vast range of nature about them that their eyes should be open to see. We must lead them first up to the plants, and only afterward inside of them. Does any one who has ever worked with young students, doubt for a moment that one of the surest ways of arousing and holding their interest in the plant world, is to open up new vistas of knowledge to them in those many plants which already claim the world's interest because of their usefulness or beauty.

So far as the teaching of botany as an observational subject is concerned, it is possible to say from personal experience, that the use of the straight observational method in an ordinary laboratory of elementary botany, conducted entirely without the use of any laboratory guides or outlines whatsoever, has proved an entirely successful experiment. The plants were placed before the students, with instructions to find out, first with the eyes, then with the simple microscope, and finally with the compound microscope, all that they could discover about them that seemed in any way characteristic, and afterwards to describe what they had observed, both in writing and by sketches, in extent, measure and proportion as they saw fit, being held responsible for getting results, but not for the manner or form of getting them. It is surprising what an amount of spontaneous observation, original in form and substance, was evoked by this method. It can be confidentally asserted that public-school pupils just entering the high school, or high-school students just entering college, and spoiled for original thinking and observation by the continual taking of notes and following of outlines, can be taken in hand by this method and trained to observe nature.

Secondly, with regard to the imparting of such botanical knowledge as will be most useful, it would scarcely seem to demand discussion, that for the majority of secondary-school pupils, that botanical training is most desirable which gives them the greatest possible amount of knowledge which can be made practically serviceable. The relation of plant physiology and structure to agriculture and horticulture, plant diseases, medicinal plants, weeds and their eradication, plant breeding, the botanical relationships of the chief families of the seed plants, and especially of the economic plants, are fields in botany that can be drawn upon for teaching purposes with the greatest profit.

A broader knowledge of the species and varieties of economic and ornamental forest and fruit trees, wild and cultivated, and of the wild and cultivated ornamental flowering plants, will also lead to an interest in introducing and growing many new and attractive forms of plant life in the community, and in the consequent adornment of homes monotonously devoid of variety and beauty.

Finally, as a means of enlightenment and of imparting culture, botany is a sadly neglected field. Between the teachers with ultra-scientific proclivities and propensities, and those who are frank agronomists, the obvious opportunities of botany in the humanistic field have been extensively overlooked. The history of the origin and migrations of the cultivated plants, and the discovery and use

of plants in primitive culture for food, clothing and household purposes, leads directly into the domain of human history and anthropology.

The study of the origins of the names of plants and their folk-lore, in connection with the literature of wizardry, magic, necromancy, the healing art and poetry, furnishes an abundance of material of decided human interest and value.

The study of the plant as a machine, in the light of its adaptations of structure to habitat, to secure survival, and to effect fertilization and the distribution of seeds and spores, in its economy in the use of material, and in its conservation of resources, is a field of distinctively cultural value. Certainly the field study of the struggle of plant societies with one another for existence and for supremacy, and with their general biological and physical environment, furnishes material for thought, analogous to the study of social evolution, and from which social lessons can be derived.

Without in any way cheapening its disciplinary value as science, a great opportunity is thus open to elementary botany, of becoming a subject of far more practical value, interest and importance, both in the field of education, and in the development of agriculture.

Herbert F. Roberts
University of Manitoba

GRANTS FOR RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At the annual meeting of the association in 1918 the Committee on Grants for Research was organized for the year 1919 as follows: Henry Crew, Chairman; N. L. Britton, W. B. Cannon, J. McK. Cattell, R. T. Chamberlin, L. I. Dublin, G. N. Lewis, G. H. Parker and Joel Stebbins, Secretary. The sum of four thousand dollars from the funds of the association was assigned by the council to the committee for distribution in support of investigations. The committee did not hold a formal meeting, but transacted all of its business by correspondence, and by the middle of June had distributed the entire sum at its disposal in the following grants.

Astronomy

Five hundred dollars to Professor E. B. Frost, of the Yerkes Observatory, for the securing, measurement and reduction of stellar spectrograms. Additional assistance in this work with the 40-inch telescope will greatly increase the mass of results being accumulated concerning the motions of stars.

Physics

One hundred and fifty dollars to Professor A. L. Foley, of Indiana University, for experiments on the speed of sound very close to the source. This investigation is in extension of the important and rather remarkable results which Professor Foley has recently published in the *Physical Review*.

One hundred dollars to Professor Orin Tugman, of the University of Utah, to meet the cost of a monochromatic source of light to be used in finding the change of conductivity in a thin metallic film when exposed to ultra-violet light—a problem which has acquired new importance in view of the rapidly developing electronic theory.

One hundred and fifty dollars to Professor E. M. Terry, of the University of Wisconsin, for work on the modulation of radio-energy employed in wireless telephony.

One hundred dollars to Professor F. C. Blake, of the Ohio State University, for aid in prosecution of a study of electric waves and dielectric constants.

Chemistry

Three hundred and fifty dollars to Dr. Gerald L. Wendt, of the University of Chicago, for the investigation of the photochemical reactions of hydrogen and chlorine. He has been able to show that under the action of alpha rays and in the vacuum discharge tube hydrogen forms a chemically very active form, which probably has the formula H_3. From a valence point of view

the existence—and even more so the properties and the method of formation—of this gas are of great interest. There is some evidence that chlorine is also activated by exposure to light, but the evidence is contradictory. The mechanism of the effect of ultra-violet radiation on chlorine, including the possibility of the existence of an ozone form of chlorine, will be investigated.

Geology

Two hundred and fifty dollars to the Seismological Society of America to enable the society to dispatch capable men to study the phenomena of earthquakes as promptly as possible after their occurrence. When an important earthquake has occurred a delay of even a few days in sending an experienced seismologist to the locus of the quake will usually mean that many important pieces of evidence have deteriorated in value or have been wholly destroyed. This grant has been made in recognition of the urgent need of the Seismological Society for a sum available for immediate use whenever there occurs an earthquake which promises to give important results.

Two hundred dollars to Dr. Roy L. Moodie, for the preparation of sections of fossil bones which show lesions of ancient disease, and for the making of photomicrographs of these sections. Dr. Moodie, by a careful study of the bones of ancient vertebrates, is succeeding in tracing many present diseases far back in the geological record. These discoveries which are opening up a new field—paleopathology—are arousing much interest both among geologists and among the members of the medical profession.

Zoology

Five hundred dollars to Professor C. H. Eigenmann, of Indiana University, to defray part of the expenses of the Irwin expedition to western South America. The object of this expedition was to collect the fresh-water fishes from parts of Peru, Bolivia and Chile and thereby to supply the necessary material for the study of important faunistic questions.

Two hundred dollars to Dr. P. W. Whiting, of Franklin and Marshall College, for investigations on the Mediterranean flourmoth and its hymenopterous parasite, hadrobracon. The money is being spent for cytological equipment, breeding boxes, and apparatus for control of temperature and humidity. The work has thus far been carried on at the Marine Biological Laboratory, Woods Hole, Massachusetts, and at Lancaster, Pennsylvania. Somatic and germinal variations, sex determination, and sex ratio are being investigated.

Botany

Five hundred dollars to the editorial board of *Botanical Abstracts* for aid in establishing this new and important periodical, which has already met with much success and provides a long-needed method of bringing the current results of botanical investigation to the service of a great number of students.

One hundred dollars to Dr. Gilbert M. Smith, of the University of Wisconsin, for aid in a study of the plankton of the lakes of southwestern Ontario.

Anthropology

Two hundred dollars to Dr. Aleš Hrdlička for *The American Journal of Physical Anthropology*. Dr. W. H. Holmes, head curator of the department of anthropology of the U. S. National Museum, wrote as follows: "Referring to Dr. Hrdlička's request for financial aid in the publication of the *American Journal of Physical Anthropology*, I take the liberty of seconding his request. The *Journal* fills a very important place in the field of anthropological science and is in the hands of our ablest students of this branch. The facts that at first the patrons of the *Journal* are necessarily limited in number and that the expenses of publication are just now nearly doubled will, I am sure, enlist your sympathy, and I sincerely trust that you may find it possible to lend the doctor a hand."

Social and Economic Science

Two hundred dollars to Miss Myra M. Hulst, of New Haven, Connecticut, for in-

vestigations into the mortality of graduates from American colleges for women. Miss Hulst reports that she has completed the mortality rates for graduates from Smith and Vassar and that she has nearly completed the tabulation of the records for Wellesley College. Preliminary results indicate that graduates from women's colleges enjoy extraordinarily low death rates, consistent with their favorable economic and social status. The research was recommended by Dr. Dublin, under whose direction it is being carried on.

Medicine

Four hundred dollars to Dr. Leslie B. Arey, of the Northwestern University Medical School, in support of his study of the origin, growth and fate of the giant cells, or osteoclasts, usually held responsible for bone dissolution. It has been found that osteoclasts arise chiefly by the fusion of depleted bone-formative cells, the osteoblasts; they further increase by taking to themselves osteoblasts and bone cells, but ultimately degenerate and disappear. There is no convincing evidence that osteoclasts are the specific agents of bone resorption. That they are degenerating, fused osteoclasts accords better with the known facts.

Education

One hundred dollars to Dr. S. A. Courtis, Detroit, Michigan, toward the expenses of securing a comparison based upon a survey of Boston schools in 1845 with present-day schools from Maine to California.

JOEL STEBBINS,
Secretary

SCIENTIFIC EVENTS

THE BRITISH ASSOCIATION AND SCIENTIFIC RESEARCH

PROFESSOR JOHN PERRY, treasurer of the British Association, made some remarks before an evening discourse on September 11, at the recent Bournemouth meeting of the association which he summarizes for *Nature* as follows:

After paying printing and office expenses, the funds of the British Association are devoted to scientific research. For more than eighty years we have spent more than £1,000 a year on research, long before ordinary people had heard of research.

Every year we form many research committees; each of them is formed of the foremost men of science of Great Britain, who receive none of the money themselves, and their accounts for mere out-of-pocket expenses are carefully audited. These researches in the past have created some entirely new sciences, have led directly and indirectly to the creation of many new industries, and they have largely produced the world's present natural knowledge. And now to my point. Yesterday a very prominent member of the association asked me about our finances. I had to admit that even before the war we were meeting with difficulties due to the increased cost of printing, and other things, that since the war we have been behindhand to the extent of more than £1,000 every year, and that we have never yet asked for the help of moneyed men. The only gift we have ever received from a moneyed man was a voluntary gift from Sir James Caird, who handed me £11,000 at the Dundee meeting. My questioner said we ought to ask for help, and that he was willing to start a fund with a sum of £1,000. At this moment he does not wish to have his name mentioned.

I need not dwell on the importance of our research work, as I feel sure that every person here who has himself done original work shares my opinion that when we limit our expenditure on research, and especially on pure scientific research, we shall begin to be a bankrupt association—bankrupt, that is, morally from the point of view of science, if not actually in the financial sense.

The moneyed men of Great Britain are most willing to help any good object when they get proof that it really is a good object. We can not complain of want of their help, for they did not know the facts. At the same time, the treasurer of an association with such a record as ours does not feel happy at the prospect of begging for help.

In the two days of the meeting following that on which I made this statement, the fund was raised to a total of £1,475. I intend to publish in due course a list of names of donors and donations.

To illustrate by many instances (as I might) our claims as to the importance of our researches would unduly prolong this letter, and any selection of a few examples would be unrepresentative. I will cite a single illustration: The National Physical Laboratory, the scene of researches of which the importance to the nation during the war and earlier can not be overestimated, had its origin

(if its antecedents be traced backward) in the Kew Observatory, which was maintained by the British Association from 1842 to 1872, in which period the association spent some £12,000 on its upkeep.

THE WORK OF THE NATIONAL COMMITTEE ON MATHEMATICAL REQUIREMENTS

A preliminary report of "The Reorganization of the First Courses in Secondary School Mathematics" prepared by the subcommittee, which was authorized to publish it was issued on November 25. It is being made the basis of discussion by organizations, committees, local groups, etc., throughout the country. Over 30 such organizations are at present at work on this report.

The whole of the meeting of the Association of Teachers of Mathematics in the Middle States and Maryland in Philadelphia on November 29 was devoted to the discussion of this report; it had a prominent place on the program of the Central Association of Science and Mathematics Teachers in Chicago on November 28 and 29 and at the meeting of the Association of Teachers of Mathematics in New England in Boston on December 6.

Committees representing organizations in the following states are actively cooperating with the National Committee: Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Iowa, North Dakota, Missouri and Texas.

Local groups or clubs are studying the report in Boston, Springfield (Mass.), Providence, New Haven, New York City, Washington, Baltimore, Cincinnati, Columbus (Ohio), Terre Haute, Chicago, St. Louis, St. Paul, Minneapolis and in several smaller cities.

Meetings in addition to those previously announced at which the work of the National Committee will be discussed are as follows: Mathematical Association of America in St. Louis, December 29 and in New York, January 2; Ohio State Teachers' Association, Columbus, December 30; Pennsylvania State Educational Association, Philadelphia, December 30; Association of Teachers of Mathematics in the Middle States and Maryland, Southern Section, Baltimore, December 13, Syracuse Section, Syracuse, New York, December 30.

The next meeting of the national committee will occur in New York City on December 30. The principal items on the program for this meeting are the consideration of the report on "The Reorganization of the First Courses in Secondary School Mathematics," the report on "The Valid Aims and Purposes of the Study of Mathematics" and the proposed revision of college entrance requirements.

The United States Bureau of Education has offered to publish the reports of the National Committee in the form of leaflets or bulletins.

A Mathematics Section of the West Virginia State Teachers' Association was organized in Fairmont on November 28. Professor John Eiesland, of the University of West Virginia, was elected chairman of the newly formed Section. Professor C. N. Moore spoke in behalf of the work of the National Committee.

CHEMICAL LECTURES AT WEST POINT AND ANNAPOLIS

The American Chemical Society has arranged a series of lectures on the relations of chemistry to problems of interest in cadets of the United States Military and Naval Academies. The lectures to be given at West Point are as follows:

Dr. Wm. H. Nichols, New York City. Sulfuric acid, the pig iron of chemistry. January 10, 1920.

Dr. Wm. H. Walker, Massachusetts Institute of Technology, Cambridge, Mass. Manufacturing problems of gas warfare. January 17, 1920.

Dr. Chas. L. Parsons, 1709 G St., N.W., Washington, D. C. Nitrogen fixation and its relation to warfare. January 24, 1920.

Dr. Henry Fay, Massachusetts Institute of Technology, Cambridge, Mass. The amorphous state in metals. January 31, 1920.

Dr. Chas. L. Reese, E. I. du Pont de Nemours & Co., Wilmington, Del. Explosives. February 7, 1920.

The lectures at Annapolis are:

Dr. Henry Fay, Massachusetts Institute of Technology, Cambridge, Mass. Iron and steel. November 15, 1919, to post-graduate student officers.

Dr. John Johnston, Yale University, New

Haven, Conn. The utilization of research. December 13, 1919, to post-graduate student officers.

Dr. Arthur D. Little, Charles River Road, Cambridge, Mass. Natural resources in their relation to military supplies. January 17, 1920, to post-graduate student officers.

Dr. Wm. H. Nichols, 25 Broad St., New York City. Sulfuric acid, the pig iron of chemistry. February 6, 1920, to midshipmen.

Dr. Willis R. Whitney, General Electric Co., Schenectady, N. Y. Industrial research. February 7, 1920, to post-graduate student officers.

Dr. W. Lee Lewis, Northwestern University, Evanston, Ill. Organic research in toxic gases. March 6, 1920, to post-graduate student officers.

Dr. Chas. L. Reese, E. I. du Pont de Nemours & Co., Wilmington, Del. Explosives. April 2, 1920, to midshipmen, April 3, 1920, to post-graduate student officers.

Dr. Wilder D. Bancroft, Cornell University, Ithaca, N. Y. Organized research. April 30, 1920, to midshipmen, May 1, 1920, to post-graduate student officers.

Dr. Wm. H. Walker, Massachusetts Institute of Technology, Cambridge, Mass. Manufacturing problems of gas warfare. May 15, 1920.

SCIENTIFIC NOTES AND NEWS

A SECTION of engineering has been established in the National Academy of Sciences and is now constituted as follows: Messrs. H. L. Abbot, J. J. Carty, W. F. Durand, J. R. Freeman, H. M. Howe, F. B, Jewett, G. O. Squier, D. W. Taylor. All members of the sections of physics and chemistry were given an opportunity to remain with the section with which they had been affiliated or to be placed in the section of engineering.

AT a recent meeting of the corporation of Yale University it was voted "to extend the sincere congratulations of the corporation to Professor Ernest Brown on the completion of his monumental work on the "Tables of the Motion of the Moon," and to assure him that the university considers the work that he has done on these volumes as among the most important scientific contributions ever made by an officer of Yale University."

WE regret to learn that Sir William Osler, regius professor of medicine in Oxford University, who passed his seventieth birthday anniversary last July, was stricken with pneumonia in November.

SIR HENRY A. MIERS, vice-chancellor of the University of Manchester, and formerly professor of mineralogy at the University of Oxford, has been elected president of the Manchester Literary and Philosophical Society.

THE Royal Meteorological Society has awarded the Symons memorial gold medal for 1920 to Professor H. H. Hildebrandsson for distinguished work in connection with meteorological science.

DR. A. PIRELLI has been elected president of an Italian Society of Chemical Industry which has been organized at Milan.

DR. J. C. MCLENNAN, professor of physics in the University of Toronto, who has since 1917 been engaged in work for the British Admiralty, will shortly return to Toronto.

DR. NELSON W. JANNEY, New York City, has been appointed director of the new Memorial Laboratory of the Santa Barbara Hospital, founded by the late Dr. Nathaniel Bowditch Potter, for research on metabolistic diseases.

DR. RALPH B. SEEM, Baltimore, assistant superintendent of the Johns Hopkins Hospital, has accepted the position of superintendent of the Billings Memorial Hospital, Chicago.

MR. CHESTER G. GILBERT has resigned from the Smithsonian Institution to accept a position on the staff of Arthur D. Little, Inc., of Cambridge, Massachusetts, which has opened a Washington office in the Munsey Building, with Mr. Gilbert in charge.

DR. E. MILLER, associate in chemistry at the Johns Hopkins University, has resigned to take a position with the DuPont Powder Company.

MR. W. J. COTTON has resigned from the color laboratory of the Bureau of Chemistry to accept a position with the National Aniline and Chemical Company, of Buffalo, New York.

WE learn from *Nature* that Captain P. R. Lowe has been appointed assistant in charge of

the bird-room at the Natural History Museum in succession to Mr. W. R. Ogilvie-Grant. Captain Lowe has for many years devoted himself to ornithological research at the Natural History Museum, the Royal College of Surgeons, and Cambridge University, and has made extensive collections of, and observations on, birds in Madeira, the Canaries, the Azores, the Cape de Verde Islands, the West Indies, Mexico, Florida, the Mediterranean islands and coasts, South Africa and the British Islands.

Dr. Joseph T. Singewald, Jr., professor of economic geology at the Johns Hopkins University, has been granted leave of absence to carry on geological investigations in northwestern Peru. He will sail from New Orleans on December 20.

Associate Professor Frederick Starr, of the department of sociology and anthropology at the University of Chicago, who is now in Japan on a research expedition, will return to the university in time to give in January a series of illustrated lectures on Mexico.

To express the admiration and gratitude in which Dr. George M. Kober is held by his pupils, friends and coworkers, it has been decided to issue as a testimonial to these sentiments an anniversary publication dedicated to him, on the occasion of his seventieth birthday, March 28, 1920. George Tully Vaughan has been elected chairman of the organization; Felix Neumann, of the Army Medical Museum, secretary; John Foy Edson, treasurer, and as members of the committee at large, General Robert E. Noble, Drs. Charles D. Walcott, Wilfred M. Barton, J. W. Fewkes, Walter D. Hough, L. O. Howard, Aleš Hrdlička, T. Michelson, W. H. Holmes and N. M. Judd. The anniversary publication will be the issue of the *American Journal of Physical Anthropology,* which will be published in the latter part of March, and will be known as the George M. Kober anniversary number.

The annual Mellon lecture of the Society for Biological Research of the University of Pittsburgh will be delivered by General W. C. Gorgas on the evening of January 8. The subject of the address will be "Yellow fever." General Gorgas is chairman of the Yellow Fever Commission of the International Health Board, Rockefeller Foundation, and has just returned to the United States from an extensive trip through Central and South America. In his address he will describe the present plans and progress of the work on yellow fever.

Professor Wm. E. Ritter, director of Scripps Institution for Biological Research, visited the University of Illinois December 2 and 3. He spoke before the graduate students and faculty on "Research Problems and Facilities of the Scripps Institution." The department of zoology tendered him a dinner at which he led a discussion on marine biology.

Dr. E. G. Conklin, professor of zoology at Princeton University, lectured on December 3 at Mount Holyoke College on "Has human evolution come to an end?"

The Boyle lecture was delivered by Professor A. Keith on November 19, at Oxford University, on "Race and nationality from an anthropological point of view."

The Harveian festival has been celebrated with full honors by the Royal College of Physicians of London, for the first time since 1913. The oration was delivered by Dr. Raymond H. P. Crawford, and dealt with the forerunners of Harvey in antiquity. After the oration the president presented the Baly Medal to Dr. Leonard E. Hill.

As a memorial of Professor J. Dejerine, Madame and Mlle. Dejerine have placed a fund at the disposal of the Paris Society of Neurology for research in neurology.

Louis Valentine Pirsson, professor of geology in the Sheffield Scientific School of Yale University, died in New Haven, on December 8, at the age of fifty-nine years. Professor Pirsson had held the chair in physical geology since 1897, and for the same period was associate editor of *The American Journal of Science.*

John Tapan Stoddard, professor of chemistry at Smith College since 1878, died on December 9.

DR. ALLAN MCLANE HAMILTON, at one time professor of mental diseases in the Cornell Medical College, died on November 23, aged seventy-one years.

THE death is announced at the age of seventy-eight years of Dr. Walter Knorre, long an astronomer at the Berlin Observatory.

DETAILED accounts of the railroad wreck in the Engo forest, Belgian Congo, in which Dr. Joseph R. Armstrong and William Stowell, both of Los Angeles and members of an exploring expedition sent out by the Smithsonian Institution and the Universal Service motion picture company, were killed have been received from railway headquarters in Rhodesia. The expedition left Sakania, Belgian Congo, for Elizabethville in a special coach attached to a freight train. While the train was stopping for fuel a water truck broke away and crashed into the rear of the train.

A CONFERENCE of representatives of the State and Local Academies of the Central States will be held at St. Louis in connection with the meeting of the American Association for the Advancement of Science. Officers of the academies are requested to meet at the Soldan High School at one thirty on Monday, December 29. Professor H. B. Ward, of the University of Illinois, whose address at St. Louis will be Hotel Statler, will be ready to give further information concerning the conference.

THERE will be a joint dinner of members of Section A of the American Association and of the American Mathematical Society on Tuesday, December 30, at 6.30 P.M. in the American Hotel Annex, 6th and Market Sts. The cost per plate will be $1.50. Those who will attend are requested to notify Professor W. H. Roever, Washington University, St. Louis, before December 26.

THE twelfth annual meeting of the American Institute of Chemical Engineers was held in Savannah, Ga., December 3 to 6. A series of papers and addresses devoted particularly to such southern industries as cotton, turpentine and rosin was presented, and excursions to the various chemical industries of Savannah and the vicinity were made.

As December 20, 1920, is the centennial of the Academy of Medicine at Paris, a committee of six members was recently appointed to have charge of the celebration of the anniversary.

THE Geological Survey of Great Britain and Museum of Practical Geology, Jermyn Street, S.W., have been transferred for administrative purposes from the Board of Education to the Department of Scientific and Industrial Research as from November 1, but correspondence with reference to the work of the Survey should be addressed as hereofore to the director of the survey and museum, Jermyn Street, S.W.

THE *Agricultural Experiment Station Journal* states that an announcement was recently made in the British parliament of a change in policy in 1918 regarding research in entomology and plant pathology through public funds. These subjects were originally allocated to the University of Manchester and the Royal Botanic Garden at Kew, respectively, with grants from the Development Fund for their support. In 1918, however, the Development Board decided that all research in plant diseases, whether due to insects or fungi, should be concentrated at a single phytopathological institute at Rothamsted, where also the board's scientific advisory staff in the subject would be stationed. Accordingly the staff at Manchester and a portion of the mycological staff at Kew were transferred to Rothamsted. A grant of $5,000, per annum, was however continued to the University of Manchester to maintain certain phases of its entomological work and also to take up work in mycology there.

CAPTAIN WILLIAM C. VAN ANTWERP has given $5,000 to the California Academy of Sciences, to meet the cost of one of the large habitat groups of California mammals which the academy is installing in its museum in Golden Gate Park. Captain Van Antwerp recently visited the museum and was so delighted with the beauty of the groups already

installed and so strongly impressed by their scientific and educational value, that he at once expressed the wish that he might be permitted to assist the museum in its efforts to be of service to the public. After conference with Dr. Evermann, director of the museum, Captain Van Antwerp selected the Roosevelt elk group as the one that he would like to finance. This group is now being prepared under Dr. Evermann's supervision. Paul J. Fair is installing the group and Charles Bradford Hudson is painting the background. The animals will be shown at the edge of a heavy redwood forest such as is found in their natural habitat in the northwestern part of California.

The erection of a new building for the Department of Health in New York City has been made possible by an appropriation of $1,000,000 granted by the Board of Estimate. The new building will be erected on a plot of ground, 100 x 100 feet, on West Thirtieth Street, between Seventh and Eighth Avenues. It will provide space for the offices of the director of the Bureau of Hospitals and for the director of the Bureau of Laboratories. Three or four floors will be given to the laboratories. The first floor will be for the Bureau of Records and another floor will be a modern health station where clinical work will be done. One floor will also be devoted to a medical library.

The *Journal* of the American Medical Association states that the Reale Accademia delle Scienze of Turin, Italy, announces that the Vallauri prize of 26,000 lire, is to be awarded for the best work on any of the physical sciences that was published in the four years ending December 1, 1918. The prize is open to foreigners as well as to Italians. The works sent in to compete for the prize must reach the Academy Via Po 18, Turin, before December 31, 1919. A further prize of 1,200 lire is offered for the best manuscript or article published since January 1, 1915, on the etiology of endemic cretinism.

We learn from the *Journal* of the American Medical Association that a new hygienic laboratory provided with the most modern equipment has been recently inaugurated at Valparaiso, Chile, in connection with the hospital of San Juan de Dios. The laboratory comprises sections devoted among others to bacteriology, chemistry and serum manufacture.

It is stated in *Nature* that the British Ministry of Ways and Communications Bill was read a third time in the House of Commons on July 10. Sir Eric Geddes, the minister-designate, announced the names of the prospective heads of departments as follows: *Civil Engineering:* Sir Alexander Gibb, civil engineer-in-chief, Admiralty, 1918. *Mechanical Engineering:* Lieutenant-Colonel L. Simpson, R.E., chief mechanical engineer in charge of railway equipment and rolling-stock of the British Armies in France. *Consultant Mechanical Engineer:* Sir John Aspinwall, president of the Institution of Civil Engineers. *Traffic Department:* Sir Philip Nash. *Finance and Statistics:* Sir J. George Beharrell. *Development Department:* Rear-Admiral Sir Charles Martin de Bartolome. *Public Safety and Labor:* Sir William Marwood, joint permanent secretary of the Board of Trade. *Roads Department:* Brigadier-General Sir Henry P. Maybury. *Secretarial and Legal:* Sir R. Francis Dunnell.

Steps are being taken by the Commonwealth Advisory Council of (natural) Science and Industry of Australia to establish a forest products laboratory, at Perth, West Austrialia, for the purpose of experimenting in the utilization of the by-products of the timber mills and of the forests. With a view to securing all the information available at similar laboratories such as those at Madison, Wisconsin, and Montreal, Quebec, Canada, Mr. I. H. Boas, M.Sc., lecturer in chemistry at the Perth Technical School, has been sent to the United States to conduct inquiries.

The board of overseers of Harvard University has recommended that the Harvard Botanical Garden should be combined with the Bussey Institution and moved to the grounds of the latter at Jamaica Plains following a report to the board of overseers of the university by the committee visiting the Botanic

Garden. The report is signed by Ernest B. Dane, of Boston, chairman of the committee; Oakes Ames, '98, director of the Botanic Garden; Edwin F. Atkins; George B. Dorr; Arthur F. Estabrook; W. Cameron Forbes; Richard M. Saltonstall; E. V. R. Thayer; Edwin S. Webster. The Botanic Garden is now situated at the corner of Garden and Linnean Streets and contains more than 5,000 species of flowering plants, which are cultivated for educational and scientific purposes. Dr. Asa Gray was its director from 1842 to 1872.

THE *Journal* of the American Medical Association states that the board of directors of the University of Cincinnati on September 9, is said to have rejected the appointments of the faculty of the industrial medicine and public health department made by Dr. Carey P. McCord. This department is not directly associated with the University of Cincinnati, although the board of directors is authorized to make appointments. The financing of the department is by subscription of business men of Cincinnati.

THERE has been established at Paris an optical institute that will work in the interest of the manufacturers of opticians' supplies; it will not be conducted for commercial profit but solely for the purpose of advancing optical science and the optical industries for the common welfare. The forms of activity of this new scientific institute will be: (1) a training school of optics; (2) a laboratory of research and experiment, and (3) a professional school for advanced study. The school of optics will train experts in the manufacture of optical goods. M. C. Fabry, at present professor of general physics at the Faculté des sciences de Marseilles, has been selected as the head of the new institution. M. Lucien Poincaré, rector of the University of Paris, has evinced an especial interest in the institute and has expressed his intention of requesting a professional chair of optics at the Sorbonne. The laboratories will comprise a research department in which the instructors of the school may conduct their theoretical and practical researches with relation to the various kinds of glass, optical instruments and opticians' accessories, and a department for the study of manufactured products or any matters of importance submitted for examination by the institute. These laboratories will serve likewise for the training of students. The purpose of the professional school will be to train workers in glass, opticians and mechanicians who shall be preeminently qualified.

UNIVERSITY AND EDUCATIONAL NEWS

WASHINGTON UNIVERSITY MEDICAL SCHOOL, St. Louis, has received $300,000 to endow its department of pharmacology. Half of this sum was given by the General Education Board and the other half was raised by the medical school.

MR. P. A. MOLTENO and his wife have offered the sum of £30,000 to the University of Cambridge, for the erection and maintenance of a suitable building, to be used as an institute for parasitological research in connection with the department of Professor G. H. F. Nuttall.

ASSISTANT PROFESSOR CHAMPION HERBERT MATHEWSON has been elected professor of metallurgy and metallography in the Sheffield Scientific School of Yale University.

DR. HARRY A. CURTIS has resigned his position at the Nitrogen Research Laboratory in order to accept a professorship in chemistry at Northwestern University, Evanston, Ill.

ISRAEL S. KLEINER, Ph.D., formerly associate in physiology and pharmacology at the Rockefeller Institute for Medical Research, has been appointed professor and head of the department of physiological chemistry at the New York Homœopathic Medical College and Flower Hospital, New York City.

DR. J. G. FITZGERALD has been appointed professor of hygiene at the University of Toronto, to succeed Dr. John A. Amyst, who has been appointed deputy minister of health in the Federal Department of Health, Ottawa.

DR. J. PROUDMAN has been appointed professor of applied mathematics in the University of Liverpool.

DISCUSSION AND CORRESPONDENCE

CHARCOAL ACTIVATION

At the thirty-sixth general meeting of the American Electro-Chemical Society held in Chicago in September, N. K. Chaney presented a paper on charcoal activation in which he states that the general theory *in its complete form rests* upon two postulates, one of which is "that elementary carbon (other than diamond and graphite) exists in two modifications, 'active' and 'inactive' or *alpha* and *beta*."

It would seem from data obtained here that the definitions of active and inactive would need to be modified before this classification can have any meaning, since charcoal can be made which is the reverse of other charcoals in that it is relatively more active for hydrogen than for nitrogen as shown by the following data:

Each of the volume measurements given were calculated from pressure readings and are reduced to normal pressure and temperature. The amount of charcoal used in each case was 25.7 gms. and this was left at liquid air temperature until saturated. The gases were used separately and not as mixtures.

Charcoal	Initial Volume	Volume of Hydrogen Adsorbed	Volume of Nitrogen Adsorbed
Usual type.......	926 c.c.	914 c.c.	926 c.c.[1]
Usual type.......	1,780 c.c.	1,657 c.c.	1,780 c.c.
New sample 1....	926 c.c.	907 c.c,	666 c.c.
New sample 2....	926 c.c.	900 c.c.	755 c.c.
New sample 3....	926 c.c.	874 c.c.	406 c.c.

The difference in treatment of the last three samples was slight yet Sample 1 shows figures lying on the outside of those for Sample 2, *i. e.*, the figures of Sample 1 have approached each other for Sample 2. Much more striking samples can no doubt be prepared.

A report of this work will be published when completed but this will serve to point out an apparent incompleteness in the theory set forth by A. B. Lamb[2] and by N. K. Chaney.

[1] Not saturated in this particular case.

[2] *J. Ind. and Eng. Chem.*, 1919, 11, 420–467.

The author is indebted to Dr. H. B. Lemon for valuable advice and assistance in this work.

H. H. Sheldon

The University of Chicago

AGED BEAN SEED, A CONTROL FOR BACTERIAL BLIGHT OF BEANS

During the progress of the investigational work on bacterial blight of beans (*Bacterium phaseoli* E. F. *Sm.*) at the Oklahoma Agricultural Experiment Station many measures for control were attempted. The most successful method so far evolved is that of eliminating the disease by the use of aged seed. It was known that the causal bacteria could be cultivated from infected seed for only a limited time.

With this fact in mind the infected seed raised in our experimental plots each year was saved and stored. Seed four and five years old has never produced blighted plants but the percentage of germination has been so low as to prohibit its use under actual farming conditions. Two- and three-year-old seed has with one exception given blight-free plants. This one exception occurred early in the work and in view of later results must be ascribed to accidental infection.

Results secured indicate that the use of two- and three-year-old bean seed furnishes blight-free plants when planted upon uninfected land and at a sufficient distance from other bean patches to insure no accidental infection. Such seed moreover has a sufficiently high percentage of germination to make its use practical under actual farming conditions.

The results of the investigational work which have been completed will be published in the near future.

C. W. Rapp

Department of Horticulture,
A. & M. College,
Stillwater, Oklahoma

NOTE ON THE FLAGELLATION OF THE NODULE ORGANISMS OF THE LEGUMINOSÆ

In again taking up the question of flagellation of the nodule bacteria, the findings re-

ported in a previous paper[1] are confirmed. Proven cultures from *Vigna sinensis* and *Glycine hispida* were repeatedly stained and examined, the organisms in every trial being found to have a single polar flagellum.

Attention was then turned to the organisms, which had before given unsuccessful stains owing to the more abundant slime production. Pure cultures isolated from the nodules of *Trifolium pratense, Vicia villosa,* and *Melilotus alba* were tried, this time successfully, though the staining of these organisms is obviously more difficult and uncertain. The bacteria in every case were found to be peritrichous. It was further noted that whereas the organisms of *Vigna* and *Glycine* have a very stout flagellum, the flagella of the organisms from *Vicia, Trifolium,* and *Melilotus* are much finer.

This confirms the work of De Rossi, Kellerman, Zipfel, and Prucha (but one convincing photomicrograph exists, that by De Rossi of *Trifolum repens*), and attention is called to the fact that these workers devoted their efforts to the more slimy group, *i. e., Vicia, Trifolium, Pisum, Phaseolus, Medicago.*

It is now evident that on the basis of flagellation, the nodule bacteria are to be divided into two distinct groups; the *Glycine-Vigna* group, and the *Trifolium-Vicia-Melilotus* group. Further observations confirming this grouping and dealing with cultural and physiological characteristics as well as with the systematic position of these and related organisms, will be the subject of a paper entitled, "The Nodule Bacteria of Leguminous Plants" soon to be published by Lohnis and Hansen.

ROY HANSEN

ILLINOIS AGRICULTURAL EXPERIMENT STATION

[1] Ill. Agr. Exp. Sta. Bul. 202.

THE SUPPOSED SCALES OF THE COTTID FISH JORDANIA

THE Cottidæ are in general scaleless, but the rare fish *Jordania zonope* Starks, from Puget Sound, is said to have the body above lateral line closely covered with ctenoid scales. Dr. D. S. Jordan has very kindly sent me fragments of one of the cotypes and the appearance is exactly as described. But when the material is treated with hot caustic potash, it is found that the apparent scales are nothing more than rows of strong ctenoid spines, placed as they would be in true scales. In the dorsal region the rows are curved as they would be were they margins of ctenoid scales. In the presumably related fossil *Lepidocottus brevis* (Agassiz), from the European Miocene, the ctenoid elements are as in *Jordania,* but the complete scales are present, with the circuli and basal radii as usual. It must be supposed that *Jordania* came from such an ancestor, and represents the survival of certain elements of scale structure without the scales, something like the grin of Lewis Carroll's Cheshire cat.

T. D. A. COCKERELL

REPORT OF THE COMMITTEE OF THE AMERICAN CHEMICAL SOCIETY ON THE PREPARATION OF A LIST RECOMMENDING CHEMICAL TEXTS FOR LIBRARIES

ON January 15, 1919, announcement was made of the appointment of Messrs. W. A. Hamor, A. M. Patterson, and L. C. Newall, as a committee for the preparation of a text for the use of librarians, in recommending books for the chemical reading of the public, in accordance with the suggestion submitted to President Nichols by Mr. Joseph L. Wheeler, librarian of the Youngstown Public Library, Youngstown, Ohio. Following the presentation of its preliminary report[1] at the Buffalo, N. Y., meeting of the society, the committee membership was strengthened by the addition of Mr. Wilhelm Segerblom.

The study of the needs of librarians which was conducted by the committee at the inception of its work, made it clear that what was most desired was an authoritative series of *reading courses,* and not a mere book-list, on chemical subjects. In fact, Mr. Wheeler formally requested a mode of presentment consisting of running texts so prepared that the

[1] See *J. Am. Chem. Soc.,* 41, 95–96 of *Proceedings.*

"prospect" would become interested in the chemical subjects discussed; and consideration of this view and the results of its own inquiry convinced the committee that, to accomplish the purposes desired, the reading courses should have a very definite publicity plan behind them.

In carrying out its work, the committee has prepared the manuscripts for a series of circulars which, it is thought, will make men want to read chemical literature. In order to accomplish that result, the committee has written lively and appealing essays, of about 1,500 words each, on elementary chemistry, household chemistry, general and physical chemistry, inorganic and analytical chemistry, organic and biological chemistry, industrial inorganic chemistry, industrial organic chemistry, and techno-chemical analysis, all of which have been divided into appropriate paragraphs, worded so as to bring out the importance of the subject and so as to impress the reader with the national essentiality of the chemical profession. Carefully selected books are mentioned casually in the texts of the courses, usually to conclude the paragraphs.

These courses should now be made available for the use of librarians who wish to reach ambitious persons who have the intelligence to follow a course of chemical study. They should, to serve the intended purpose, be published in attractive booklet form for distribution at libraries to persons who are engaged in chemical work or interested in the specific subjects of the various courses, and to persons who are as yet only casually engaged or interested, but who may think of becoming well-informed on chemical subjects.

It is therefore recommended that the committee be authorized to furnish Mr. Joseph L. Wheeler with copies of the manuscripts, in order that he may endeavor to arrange for their publication *in toto*, and that the present committee be designated to cooperate with Mr. Wheeler in that undertaking and in stimulating interest in chemistry through the media of libraries. It is also recommended that the courses be published by the society in *The Journal of Industrial and Engineering Chemistry*.

The committee is grateful for the privilege of rendering this public service, for, as in Carlyle's time, "the true university is a collection of books," expertly selected and properly used.

W. A. HAMOR

MELLON INSTITUTE,
PITTSBURGH, PA.,
August 29, 1919.

SPECIAL ARTICLES

AN UNEXCELLED MEDIUM FOR THE PRESERVATION OF CADAVERS

ONE can not contemplate the history of human dissection without a profound sense of gratitude for the discovery of three chemicals, the use of which in embalming has completely transformed the laboratory of gross anatomy. Could they have been introduced earlier, human dissection long since would have lost its forbidding aspect. Although Scheele discovered glycerin in 1779, it was not used for the preservation of anatomical material until 1868, almost a century later. This was not until a year after formaldehyde had been discovered by Hoffman and, although the antiseptic properties of the latter were not revealed till twenty years later. this event soon was followed by its introduction into histologic and gross anatomic technique in 1890 by Blum, junior and senior respectively. The earlier discovery of phenol by Runge in 1834, with the subsequent relation of its antiseptic properties by the revolutionary usage of it in surgery by Lister in 1867, and its application in the preservation of anatomic material by Laskowski in the same year, or even in 1864, completes the trinity of substances so largely responsible for freeing dissection of the human body from the noisome burden previously imposed by post mortem decay. An occasionally delayed necropsy still can suggest to present-day medical students just what this freedom meant to anatomists and students of anatomy of the past. Surely nothing has been a greater boon to human anatomy and anatomists than the miracle wrought by these and other chemicals, the proper use of which bids fair to make our anatomical laboratories practically odorless.

For unless the bodies can not be obtained soon enough after death to make proper preservation possible, the human anatomist or medical student no longer need labor in an atmosphere which announces their presence even to those who seek them not.

While we have been exceedingly fortunate in the matter of embalming the dead, and have improved upon the historic—or even geologic—method of cold storage by adapting current commercial equipments, much yet remains to be desired in this respect. Several years since, while reflecting upon the various methods now in use, it occurred to me that mineral oil ought to possess many advantages. Since various vegetable oils, notably turpentine, oil of cedar, benzol, etc., had been used, it seemed strange indeed that mineral oils also should not previously have been resorted to. This would seem particularly likely during the last decades in which oil played such a very prominent rôle in the industries. It semed all the more perplexing that mineral oils should not have been resorted to because resins, pitch, tar, etc., had been used centuries ago for the very purpose. Moreover, attempts also had then been made to imbed the dead in honey, resin and fats, after the manner of nature in imbedding insects in amber. It is true that nature also made such experiments with crude oil on a gigantic scale at La Brea, but that is a relatively recent discovery. Nevertheless, it seems strange that the finding of these beds with their rich booty, some years since did not suggest the use of mineral oils for the storage of anatomic material to me or, for that matter, to others. Indeed it is so inexpensive when contrasted with cold storage that it seems that it could not have been overlooked in the course of the development of modern methods for embalming and preserving material for dissection. However it is possible that the use of crude oil was considered and abandoned before the development of modern methods of distillation, because crude petroleum very plainly would seem to be quite unsuited for the purpose.

Cold storage, while excellent for the preservation of material for short periods of time, demands not only a considerable initial expense, but also imposes a relatively high cost of maintenance. With its use it also is difficult to prevent marked shrinkage of the material, in the course of months and years. The same thing applies to the storage of material in tanks over methyl alcohol. Immersion in a watery solution, on the other hand, while obviating this difficulty, introduces others. Since the water penetrates the bodies, it abstracts the preservatives from the tissues, and bodies so immersed dry quickly when exposed to an atmosphere of low humidity. While drying during storage is obviated by submersion in watery solutions the bodies often remain at or come to the surface and must then be depressed. Evaporation of the water also carries odors with it, besides reducing the total quantity of fluid. A room full of tanks containing oil on the other hand remains practically odorless and needs no further attention.

While most of the difficulties except drying experienced with other methods are obviated by storage of the cadavers on open racks after covering the material with a thick coating of vaseline, the application of the latter is time-consuming, relatively expensive, and does not make for tidiness. Moreover, portions of the skin easily become uncovered of vaseline and dry, and when the nose, mouth and eyes are not thickly coated, mold also can get a foothold, in spite of the extra wrapping required.

With the use of all these methods, except immersion in a water solution, inspection of the material is difficult, while it is exceptionally easy with the use of oil. Moreover, the oil extracts practically nothing from the material and softens and later protects the epidermis. Since its specific gravity is low, bodies easily sink by their own weight. Hence, as long as there is sufficient oil in the tanks, all material is hermetically sealed and no spontaneous subsequent exposure need be feared, for there is practically no loss through evaporation. Material stored in it for over two years appears to be in identically the same condition as when first immersed. Since bodies which have become decidedly œdematous during the process of embalming may be ex-

posed over methyl alcohol for varying periods of time before immersion in oil, one can always reduce, even if not totally remove, the inevitable distortion due to the injection of considerable quantities of preservative, and be assured that the material comes out of the oil unchanged. Since carbolic acid when warmed, easily and thoroughly mixes with oil, it can be added if desired, but so far I have not observed the least disadvantage from the use of unmixed oil alone.

Material immersed in oil need drain only a few minutes before it can be wrapped or covered and used for dissection. The wrapping quickly takes up the slight amount of adhering oil, and by being impregnated with it, greatly slows the drying out of the material. Except for the slight odor of the oil, bodies so stored are practically odorless, and quite in contrast to those kept in watery solutions, leave practically no evidence of external contact even when handled with bare hands. After being thoroughly impregnated with oil the epidermis resists drying very much better, and the eyelids, nose, lips, digits, ears and genitalia do not require such careful protection during dissection. But above all else the untidiness and soiling, unavoidable especially when vaseline is used, are wholly obviated.

Since any wooden tank can be used as a container, no expensive equipment is required. A galvanized iron lining no doubt will last indefinitely, and cement tanks have not been found too pervious. Exposure to cold can cause no difficulty, and, if introduced accidentally, water can be drawn off easily. The cost of the oil is low, especially when its practical permanence is considered, and since it is not easily ignited until it reaches a temperature of 80° C., underwriters have raised no objections to its use. Lighted matches can be thrown into open tanks without causing an explosion of gases or igniting the oil. Indeed some heating of the latter when contained in an open vessel is necessary before explosion of the liberated gases occurs. Consequently, ordinary care is all that is required to avoid accident when in its presence.

The particular grade of oil which I have used for several years is known as mineral seal oil. It has a slight yellowish tinge, and a specific gravity of 0.85 at room temperature. It has only a slight odor, which is wholly inoffensive, and, in fact, negligible. Since it can be obtained in large quantities and does not need renewal, it is extremely economical, and since it is almost colorless, it can be used to advantage also for preserving smaller specimens and even for museum preparations. It indeed seems to be an unexcelled medium for the storage of anatomical material. That this estimate of it is justified seems to be indicated also by the experience of friends who are using it. It would seem to be particularly advantageous when it is necessary to store material for long periods of time because of an intermittent or insufficient supply, or when, for some reason, it is desired to repeat measurements or to make volumetric determinations, at a later date.

ARTHUR WILLIAM MYER
STANFORD UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY. VI

RUBBER DIVISION

John B. Tuttle, *Chairman*

Arnold H. Smith, *Secretary*

Report of Executive Committee.

Report of Secretary.

Report of Fruit Jar Ring Committee. L. J. PLUMB, chairman.

Report of Committee on Physical Testing. H. E. SIMMONS, *chairman*.

A new method for the determination of sulfur in rubber mixtures: G. D. KRATZ, A. H. FLOWER AND COLE COOLIDGE. Transfer the finely divided samples (0.5 gm.) to an Erlenmeyer, and add 10 c.c. of $ZnO + HNO_3$ solution (200 gms. ZnO in 1 liter HNO_3). Then add 15 c.c. fuming HNO_3, whirling the flask until the sample is decomposed. When solution of the rubber is complete, add 5 c.c. $Br\text{-}H_2O$ and evaporate mixture to a foamy syrup. Cool flask and add a few crystals of $KClO_3$. Evaporate the mixture to dryness and bake at the highest temperature of a Tirrell burner until all nitrogen compounds are eliminated. When baking is

complete, cool, take up in HCl (1:6), filter and precipitate sulfates in the usual way, especial care being observed in washing $BaSO_4$ free from chlorides. The method is accurate to 0.1 per cent.

The extraction of rubber goods: S. W. EPSTEIN AND B. L. GONYO. A report is made of experimental work on the rubber extraction of rubber goods, with tables showing results obtained. The observations and conclusions derived from this work were as follows: (1) Extraction for 8 hours with acetone followed by 4 hours extraction with chloroform does not remove all soluble material from some rubber compounds. (2) After a rubber sample has been extracted with acetone it was found: (*a*) that chloroform in every case extracted slightly more material than carbon bisulphide; (*b*) that constant boiling mixtures such as 55 per cent. carbon bisulphide—45 per cent. acetone and 68 per cent. chloroform—32 per cent. acetone extracted from many cheap compounds considerably more material than either chloroform or carbon bisulphide; (*c*) that usually about 0.1 per cent. of sulphur is present in the extract, whether it is obtained by the use of chloroform, carbon bisulphide, or the mixtures under consideration. (3) The constant boiling mixture of 68 per cent. chloroform and 32 per cent. acetone exhibits a marked ability to dissolve vulcanized rubber, as contrasted to the mixture of 35 per cent. carbon bisulphide 45 per cent. acetone which hardly exhibits this ability at all. (4) It is recommended that the constant boiling mixture 55 per cent. carbon bisulphide and 45 per cent. acetone be used in place of acetone and chloroform to extract rubber samples since: (*A*) It eliminates one extraction with the necessary weightings. (*B*) Extraction is complete in 8 hours while the acetone and chloroform extractions require a total of 12 hours. (*C*) The extraction of free sulphur is complete. (*D*) A rubber analysis in which the mixed solvent is used, is more accurate than that in which acetone and chloroform are used, because (I.) Little or no rubber is dissolved by this mixture, as compared to chloroform which will in some cases dissolve considerable quantities. (II.) The extraction of cheap rubber compounds is more complete, since the extracts obtained are greater than the sum of the acetone and chloroform extracts.

The theory of balloon fabric protection: JOHN B. TUTTLE.

The expansion of rubber compounds: C. W. SANDERSON. A new apparatus was designed to measure the expansion of rubber compounds during vulcanization. Values of the coefficient were determined for different classes of compounds and found to be between 2.3×10^{-4} and 3.8×10^{-4}. A study of the relation between the expansion and the increase in specific gravity was made and the conclusion drawn that the increase in specific gravity during vulcanization is due to the pressure exerted on the rubber. Other experiments were made to determine the applicability of the measurements to commercial practise.

Volume increase of compounded rubber under strain: H. F. SCHIPPEL. The addition of pigment to rubber changes it from a substance which has constant volume under strain, to one which undergoes comparatively large volume increases. The amount of this increase depends upon three factors: (1) the extent of strain, (2) the volume proportion of pigment, (3) the average particle size. The larger sized pigments cause greater volume increases, with the notable exception of zinc oxide, which classifies itself under this test with the finer pigments. Prolonged mixing on the mill has only a slight reducing effect upon the volume increase. This general property of rubber compounds throws light upon their physical condition under strain.

The determination of cellulose in rubber goods: S. W. EPSTEIN AND R. L. MOORE. After a discussion of the value of a procedure for determining cellulose in rubber goods and consideration of the literature on the subject, the proposed method is discussed. Sample is digested with cresol at 160°–185° C. for 4 hours to dissolve the rubber. Filtration is facilitated by addition of a 200 c.c. of petroleum ether. After washing with benzol, 10 per cent. solution of hydrochloric acid, water and acetone, the material is dried and weighed. It is then acetylated by heating for 30 minutes at 75° C. in a mixture of 15 c.c. of acetic-anhydride and 0.5 c.c. of concentrated sulphuric acid. This is filtered on a weighted Gooch, washed with 90 per cent. acetic acid and then with acetone and dried and weighed. Loss in weight is recorded as cellulose. Under Results of Analysis are given a number of test compounds, containing varying amounts of cellulose in the presence of various combinations of compounding ingredients. The results by method given indicate its gratifying accuracy. A number of alkali reclaims are given along with cellulose content as obtained by method proposed. It is shown how the percentage of cotton can be

obtained in the presence of leather. Leather, wood, jute and cork are considered. These are broken down by cresol at 185° C. For this reason it is suggested that rubber be digested in cresol for 16 hours at 120° C. when the presence of these is suspected. At this temperature the basic substance of these materials is retained intact. Acetylation gives:

95 per cent. of the wood,
90 per cent. of the jute,
70 per cent. of the leather,
21 per cent. of the cork.

An approximation of the amount of cork present is obtained by treating the residue after acetylation with 2 per cent. solution of sodium hydroxide and strong bromine water, in order to remove the unacetylated cork. The loss in weight represents 70 per cent. of the total amount of cork present. It was found impossible to determine each of these ingredients separately, and therefore it was decided to determine them collectively by the acetylation method, and to test for the presence of each by means of proper stains and microscopic examination.

The variability of crude rubber: John B. Tuttle.

Symposium on the action of accelerators during vulcanization: J. H. Scott.

The action of certain organic accelerators in the vulcanization of rubber: G. D. Kratz, A. H. Flower and Cole Coolidge. The activity of the following substances in accelerating the vulcanization of a mixture of 92½ parts rubber and 7½ parts sulfur was investigated: aniline, urea, thio-urea, mono- and di-phenyl-thio-urea, mono-, di- and tri-phenyl-guanidine, the formaldehyde condensation products of aniline and p-phenylene-diamine, and other substances, including those which produce negative acceleration. Comparisons were made on the above mixture; sulfur coefficients are given. Certain substances were found to decompose into simpler substances containing an active nitrogen group which is responsible for the acceleration effected. Molecularly equivalent quantities of substances which contain the same active nitrogen group in their primary nucleus produced the same accelerating activity. Certain nitrogen groups probably function as sulfur carriers with a temporary change from three to five in the valency of the nitrogen.

Reactions of accelerators during vulcanization: C. W. Bedford and Winfield Scott.

The effect of organic accelerators on the vulcanization coefficient: A brief discussion of the already published work on the relationship of the mechanical properties of vulcanized rubber to the chemical composition, and a description of experiments with certain powerful accelerators which demonstrates that under certain conditions good mechanical properties can be obtained in rubber with a very low degree of chemical combination of sulphur.

The effect of compounding ingredients on the physical properties of rubber: C. Olin North.

Some methods of testing the hardness of vulcanized rubber: H. P. Gurney.

Symposium on the testing of pigments. Led by Geo. Oenslager. Contributions from M. M. Harrison and M. M. Kahn.

The manufacture and use of crimson antimony: J. M. Bierer.

Laboratory aprons: C. P. Fox.

The value of a library to the rubber laboratory: H. E. Simmons.

Research on zinc products for the rubber industry: P. R. Croll and I. R. Ruby.

DYE SECTION

Charles L. Reese, *Chairman*
R. Norris Shreve, *Secretary*

Introductory remarks: Charles L. Reese.

Present condition of German dyestuff plants: T. W. Sill.

Review of the dye situation: J. Merritt Matthews.

The progress of the American dye industry as shown by the census of the Tariff Commission: Grinnell Jones.

Photosensitizing Dyes: E. Q. Adams.

The color laboratory of the Bureau of Chemistry: H. D. Gibbs.

Alkali fusions: H. D. Gibbs and Max Phillips.

The system: napthalene-phthalic anhydride: K. P. Monroe.

The melting point of pure phthalic-anhydride. The system: phthalic anhydride-phthalic acid: K. P. Monroe.

Benzene sulphonic acids. (I.), benzene disulfonic acid from benzene mono sulfonic acid: C. E. Senseman.

Notes on testing dyed goods: W. F. Edwards. During the war period established prejudice made

a condition that favored placing the blame for defects in dyed goods on the dyer and the American Dye Manufacturers. It has been an easy way for uninformed persons dealing in dyed finished goods to avoid responsibility for defects in the goods which they handle. It is necessary to show these dealers in dyed goods that there are ways of practical testing within their reach that are comparatively safe in showing the color quality of the goods they handle. This would be also great value to the dyer and dye manufacturer as the tests could be made by disinterested laboratories. These tests should be simple and reliable and as fast as possible standardized. The textile testing department of the United States Conditioning & Testing Co. has been making some investigations along this line and have done enough to show that it is quite practical to place the color quality of dyed finished goods on as sound a basis of specification as now obtains for steel and other alloys. In the case of steel the specifications are in terms of chemical analysis, micro-structure and physical tests. In the case of dyed finished textiles the specifications for color quality are in terms of fastness in some form or other and hue, saturation and brilliancy and are determined by empirical tests under controlled conditions. These are details of standardization of these empirical tests that are important to consider from the point of view of the manufacturer of dyes, the dyer and the dealer in dyes and dyed finished goods. Team work by all will lead to results that will insure the future of the American dye industry.

The quality of American dyestuffs: R. S. LUNT. After a review of pre-war dyestuff conditions the author spoke of the early attempts to produce intermediates and dyestuffs in America. The first dyestuffs produced for large tonnage though few in variety. Indigo, only commenced in 1917, now supplies the entire demand. The study and production of alizarines and vat dyes required time but these colors are now almost ready to put on the market. Azo colors, forming the bulk of the production, form a varied line. The Chemical Foundation has provided access to German owned American patents. Present dyestuff industry now comprises 215 concerns employing 26,000 hands, of whom 2,300 are chemists. The great need of the dyestuff chemist is pure standardized intermediates, 141 are now being made. Most manufacturing problems are due to lack of experience. Standardization must rest on a basis of commercial products rather than on chemical purity. The present productions are satisfactory but there is a need of press cooperation and favorable legislation. The American chemists are now in control of the situation.

Application of dyes: E. W. PIERCE. The author first shows the earliest methods of coloring fabrics by printing and dyeing, tracing the progress of the art to the present high state of development. It is shown that dyes must be more than mere colors; they must have definite characteristics and be practical in their applications. Many possible dyestuffs are little used for lack of proper methods of application. The uses and possibilities of any dye determine its value more than any other factor. The importance of technical service is shown in its relations to both the dye maker and the consumer, also the future development of the industry, dependent on the verdict of the technical department, which will determine which new dyes shall be introduced and which ones are not capable of practical development.

Foreign dye patents: ROBERT E. ROSE. The difficulty of ascertaining the method of making dyes, even those covered by patents, is much greater than is appreciated, a fact which has never been given publicity. The paper explains the reason for this and shows that overcoming this difficulty is one of the most important tasks before the dye chemists of the country.

Some stones in the foundation of a great national industry: THOMAS H. NORTON. The effort to build up an American coal-tar dyestuff industry, fully equipped to meet the rivalry of the German industry, is outlined. The chief factor in favor of the latter is its enormous capital of accumulated experience and perfect organization. Details are given of the principles and methods employed by the du Pont Company in seeking to establish color works on American soil, equal in extent and variety of product, to any of the giant works on the Rhine. Emphasis is laid upon the work of the "Intelligence Division" which furnishes prompt, accurate and full information on any subject arising, to the numerous divisions engaged in operation or research.

The explosibility and inflammability of dyes: BURR HUMISTON, W. S. CALCOTT AND E. C. LATHROP. A presentation of the factors which cause decomposition of dyes during drying grinding and mixing with special emphasis on explosion and fire risk. Decomposition is due to temperature effects, especially dangerous in exo-

thermic decompositions. The laboratory methods used are designed to deal with decompositions in both solid and dust air phases. Preliminary results are promising finding application in plant practise, insuring more uniform quality in the dyes produced.

Some problems in the identification of dyes: E. F. Hitch and I. E. Knapp. It is pointed out that before the American dyestuff manufacturers can develop new colors, they must be able to duplicate the staple foreign dyes, especially the more recent ones, and those which are unclassified. In order to do this it will be necessary to identify these dyes, and in many instances to determine their chemical constitution. The first class of problems that are likely to be met includes (1) the identification of two or more dyestuffs, the composition of one of which is known; (2) the determination of the chemical constitution of an unknown dyestuff; and (3) the separation and identification of the component of a mixture of dyestuffs. The problems in class two deal with the identification of dyestuffs on the fiber. The methods which have been proposed for the solution of these problems are reviewed. In conclusion, a plea is made for closer cooperation between the universities and the dyestuff industry. Several ways are shown in which such cooperation might be effected.

Indicators and their industrial application: H. A. Lubs. The most recent and useful developments in the field of indicators are largely due to need for a series of brilliant and sensitive compounds for the colorimetric determination of H^+ ion concentration of biological fluids. This necessity has given rise to the study of the ranges, and of the salt, protein and other errors of a large number of compounds, as well as to the synthesis of new indicators. The sulfophthalein series of indicators are brilliant compounds and cover a wide range of H^+ ion concentration. These compounds are superior in a number of respects to indicators in general use at the present time and their application in a number of industrial operations would be highly advantageous. The lack of reliability in the case of test papers of litmus and phenolphthalein is pointed out and the use of sulfophthaleins is suggested. Examples of certain procedures in the preparation of dyes and intermediates in which indicators can be of assistance are given.

Vat dyes: M. L. Crossley.

Gentian violet and its selective bactericidal action: M. L. Crossley.

The importance of intensive and original research in the development of the dye industry in America: M. L. Crossley.

Logwood in its relation to the silk industry: Emil Lesser and David Wallace.

Some engineering aspects in the manufacture of dyes: Clarence K. Simon.

Observations on the estimation of the strength of dyes: W. H. Watkins.

Application of physical chemistry research on dyes: E. K. Strachan.

Crystallographic identification of five isocyanines: Edgar T. Wherry. Five isomeric or closely related isocyanine dyes have been prepared in the Color Investigation Laboratory of the Bureau of Chemistry by Dr. E. Q. Adams, and crystallized from alcohol. The crystals prove to show brilliant color phenomena, and especially the rare effect known as reflection-pleochroism, the reflection of light of different colors in different crystallographic directions. Models of these crystals have been prepared (and were exhibited at the meeting). It is ordinarily not practicable for any one not specifically trained in crystallography to carry out measurements of interfacial angles of random crystals, because it is a matter of great difficulty to orient given crystals correctly. The fact that the crystals of these dyes have definite colors associated with definite crystallographic directions makes such orientation comparatively easy, and which dye is represented in a given sample can be rapidly and certainly ascertained by a few simple observations of angles, far more readily than by any known chemical method.

The dye situation in the United States and England: T. Frusher.

Charles L. Parsons,
Secretary

(*To be continued*)

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CONTENTS

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THE BUILDING OF ATOMS AND THE NEW PERIODIC SYSTEM[1]

What is usually known as the periodic system of the elements was developed largely in the decade from 1860 to 1870, during the period of our civil war, by de Chancourtois, Newlands, Mendeléeff and Meyer. Mendeléeff, the third to develop the system, has been given almost all of the credit for it, but this is largely because he paid very much more attention to its details than any of the three others. It has now been found that the Mendeléeff periodic relation is simply one method of expressing the arrangement in space of the electrons in the outer part of the various kinds of atoms.

Five years ago I discovered a *new periodic system of the elements, or more properly speaking, of the atoms. This second system is not at all directly related to the arrangement of the electrons in the outer part of the atom, but has been found to indicate how the atoms are built up, that is, it is related to the structure of the nuclei of the different species of atoms.*

In order to understand the meaning of this new periodic system it is important to have a good idea of the present theory as to the general structure of the atom. According to Rutherford the atom is similar to the solar system in that it has a central sun called the nucleus of the atom, and a system of planets, each of which consists of one negative electron. The atom as a whole is electrically neutral, and the electrons outside the nucleus, which we may call the planetary electrons, are held in the atom by a positive charge on the nucleus. This positive charge is equal numerically to the sum of the charges of all of the planetary electrons. This is often expressed

[1] Abstract of a general address presented at the Philadelphia meeting of the American Chemical Society, September 3, 1919.

by the statement that the number of positive charges on the nucleus is equal to the number of negative electrons, since it is known that the hydrogen ion carries a positive charge equal to the negative charge on the negative electron.

The atom is similar to the solar system in a second sense, for the planetary electrons are, relative to their size, about as far from each other and from the nucleus, as the planets and the sun. Thus it need not be surprising from this point of view, that Rutherford has found that the very minute nucleus of a helium atom, often called the alpha particle, may be shot directly through many thousands of other atoms, without hitting a single nucleus or a single negative electron, just as a planet like the earth might be shot through thousands of solar systems like our own without hitting a single sun or planet.

The atom is like the solar system too, in that the nucleus, like the sun, possesses nearly the entire mass of the system, since in general the nucleus is more than two thousand times heavier than all of the electrons which surround it. While the atom is so small that a row of fifty million atoms would be only about one inch long, if they were put as closely together as they are in solids; and so small too, that there are 180 thousand billion billion atoms of carbon in one cubic centimeter of diamond; the atom is so *large* compared with the electron, that, if we take the dimensions usually accepted for the electron, there would be space in a single atom sufficient to contain ten million billion electrons, while the atom which contains the greatest number of planetary electrons, uranium, actually has only 92 of these. According to the work of Rutherford, Geiger, Darwin and Marsden, the nucleus of even the heaviest atom, is not very much larger than a negative electron. Thus the atom may be said to be very sparsely populated with electrons.

The atom is *unlike* the solar system in that the planetary electrons are arranged more or less symmetrically in space around the nucleus, at least that is the idea expressed in papers by the American chemists, Parsons, Harkins, Lewis and Langmuir, the last two having paid the most attention to the details of the arrangement. Also, while the solar system is held together by the gravitational attraction between the large mass in the sun and the smaller masses in the planets, the atoms are held together by the positive electrical charges in the nucleus and the negative charges of the electrons, together with whatever magnetic effects are produced by the rotation of the electrons.

THE BUILDING OF ATOMS

While chemists have not as yet synthesized any atoms, it is also true that they have only recently begun the study of their structure. Now, when a chemist wishes to build up even such a simple thing as an organic molecule, he first studies its structure, and often many years intervene between the working out of the structure of the molecule and its first synthesis. In the synthesis of an organic dye there may be two steps which we may have to consider. Suppose for example that the first of these consists of a complex set of reactions which are very difficult to carry out, while the second step will occur by itself if the intermediate product is only left standing in the air. It is evident that the practical chemist will need to put almost his whole attention on the first step of the synthesis. The building of atoms is similar in that the first step, the building of the nucleus of an atom, has not yet been accomplished, while, if the nucleus were once built, it would of itself pick up the whole system of planetary electrons which would turn it into a complete atom. For example in the disintegration of the nuclei of certain radioactive atoms, alpha particles which are the nuclei of helium atoms, are shot out as rapidly as twenty thousand miles per second, so rapidly that they pass through as many as *half a million* other atoms before coming to comparative rest. Now Rutherford has proved that when these nuclei finally slow down, they give the ordinary spectrum of helium, which indicates that each alpha particle has picked up the two negative electrons which are essential to convert it into a complete helium atom.

THE BUILDING OF THE NUCLEI OF COMPLEX ATOMS

Suppose that we consider the specific problem of the building of a carbon atom. The characteristic chemical and physical behavior of carbon are due to its six planetary negative electrons, and these will arrange themselves around any nucleus which carries a positive charge of six, so our problem reduces to that of putting six positive charges of electricity into the extremely minute space occupied by the nucleus of an atom, with a diameter of the order of 10^{-12} cm., that is one millionth of a millionth of a centimeter. These six positive charges must not only be put into this *ultra-ultra-microscopic* space, but must unite to form an intra-nuclear compound of extreme stability.

Now, up to the present time, the smallest mass ever found associated with one positive electrical charge, is that of the hydrogen ion, which is associated primarily with the mass of the hydrogen nucleus, with a value of 1.0078.[2] If six of these hydrogen nuclei could be packed tightly enough together to form the nucleus of a new atom they would form the nucleus of a carbon atom, which would have a mass of approximately six. That no carbon atom of this mass exists, is not because such a nucleus if formed, would not give a true carbon atom, but because six positive hydrogen nuclei undoubtedly repel each other, and can not be made to form a stable system.

In order to make a complex nucleus stable it is necessary to include not only hydrogen nuclei, but also negative electrons. Since the mass of the ordinary carbon atom is 12.00, it could be built up from 12 hydrogen nuclei, bound together by six negative electrons. Such a nucleus would have a positive charge of 6, it would therefore take up six negative electrons, and would thus form a complete carbon atom. The only objection to this idea is that 12 times 1.0078 is 12.036, while the weight, and probably the mass, of the carbon atom is only 12.005, or the actual carbon atom is 0.76 per cent. lighter than it should be if built from 12 hydrogen nuclei without any resulting change of mass. Now Professor A. C. Lunn has worked out the mathematical expression for this effect for the writer, and this shows that according to the electromagnetic theory, if such a nucleus is held together in a very small space by attractive forces there *should* be a loss of mass in its formation, and that in a simple atom the observed loss of mass would result if the center of the negative electron has a distance 400 times the radius of the positive electron.

[2] Equal to 1.66×10^{-24} grams.

The alpha particle, or the nucleus of a helium atom, carries two positive charges, has a mass of four, and is probably made up of four positive hydrogen nuclei bound together by two negative electrons into what is probably by far the most stable nucleus of any known atom, except that of hydrogen itself.

If we make the atomic number of the element equal to the positive charge on the nucleus, then the atomic number of hydrogen would be one, that of helium two, that of carbon six, of lead eighty-two, and of uranium, ninety-two. Now the mass of the carbon atom (atomic number 6) is exactly what it should be if its nucleus consists of 3 alpha particles. Also, 3 times the charge on the alpha particle is just the charge on the carbon nucleus. It is easily seen that there is a possibility that the carbon nucleus is simply a compound made up of 3 alpha particles, of a formula $3\,\alpha$. Now it is obvious that if the nuclei of complex atoms were simply structures built up from alpha particles, that, since the positive charge on the alpha particle is two, there would be no nuclei with an odd number of charges. The work of Mosely indicates, however, that the elements of odd atomic number also exist, but it is certain that the nuclei of such odd numbered atoms can not be compounds made of alpha particles alone.

On the other hand, it is quite evident, as I announced four years ago, that the nuclei of the atoms of even atomic number are mostly intra-nuclear compounds of helium nuclei. For this there is much evidence which will be found in my printed papers in the *Journal* of the American Chemical Society and in Science. This evidence can only be hinted at here, since the time for the paper is short,

TABLE I

The Helium—H_3 System of Atomic Structure H = 1.0078

He = (4 H) = 4.00

	1	2	3	4	5	6	7	0	8	
At. No. . .	3	4	5	6	7	8	9	10		
	Li	Be	B	C	N	O	F	Ne		
Ser. 2 . . .	$He+H_3$	$2He+H$	$2He+H_3$	3He	$3He+H_2$	4He	$4He+H_3$	5He		
Theor. . . .	7.00	9.0	11.0	12.00	14.00	16.00	19.00	20.0		
Det.	6.94	9.1	11.0	12.00	14.01	16.00	19.00	20.0		
At. No. . .	11	12	13	14	15	16	17	18		
	Na	Mg	Al	Si	P	S	Cl	A		
Ser. 3 . . .	$5He+H_3$	6He	$6He+H_3$	7He	$7He+H_3$	8He	$8He+H_3$	10He		
Theor. . . .	23.0	24.00	27.0	28.0	31.00	32.00	35.00	40.0		
Det.	23.0	24.32	27.1	28.3	31.02	32.07	35.46	39.9		
At. No. . .	19	20	21	22	23	24	25		26	27
	K	Ca	Sc	Ti	V	Cr	Mn		Fe	Co
Ser. 4 . . .	$9He+H_3$	10He	11He	12He	$12He+H_3$	13He	$13He+H_3$		14He	$14He+H_3$
Theor. . . .	39.00	40.00	44.0	48.0	51.0	52.0	55.00		56.00	59.00
Det.	39.10	40.07	44.1	48.1	51.0	52.0	54.93		55.84	58.97

Increment from Series 2 to Series 3 = 4He. Increment from Series 3 to Series 4 = 5 He (4 He for K and Ca). Increment from Series 4 to Series 5 = 6He.

Note: The simple helium system begins with carbon (= 3 He), and continues with oxygen (4 He), neon (5 He), magnesium (6 He), silicon (7 He), sulphur (8 He), argon (10 He), calcium (10 He), titanium (12 He), chromium (13 and iron (14 He).

While both the argon and the calcium atom are built from 10 helium atoms, the nucleus of the argon atom contains 10 alpha (α) particles alone, while the nucleus of the calcium atom contains 10 alpha particles with two negative electrons which serve to bind on one of the alpha particles. These may be called binding electrons.

The composition of the thorium nucleus is expressed by the formula $\alpha_{58}\epsilon_{26}$, that of the nucleus of the uranium atom by $\alpha_{59}h_2\epsilon_{28}$, and that of the isotope of lead which comes from radium as $\alpha_{51}h_2\epsilon_{22}$.

and I wish to show just a little as to the way in which these alpha particles are bound together.

First, the atomic weights of the lighter atoms of *even* atomic number beginning with carbon are, 12, 16, 20, 24, 28, 32, 40, 40, 48, 52 and 56, the last being the atomic weight of iron, of atomic number 26. Thus the atomic weights of the atoms whose nuclear charge is expressed by an even number, are divisible by 4, the weight of the helium nucleus. If we study the elements of high atomic number, beginning with uranium, which is number 92, we find that the even numbered atoms change into the atom of next lower even number by the loss of a single alpha particle from the nucleus of the atom. Thus we find just the same system of structure indicated by the actual disintegration of the radioactive atoms, as is made evident by the atomic weights and the nuclear charges on the atoms of low atomic weight.

Second, the atomic weights of the elements of odd atomic number point to the idea that their nuclei are compounds of a certain number of alpha particles with three hydrogen nuclei, so that their formula is $n\alpha + 3h$ In the exceptional cases of nitrogen the formula is $3\alpha + 2h + \epsilon$.

Four years ago I presented the following formula for the respective nuclei:

$$\text{Carbon nucleus} = 3\alpha$$
$$\text{Nitrogen nucleus} = 3\alpha + 2h + \epsilon$$
$$\text{Oxygen nucleus} = 4\alpha$$

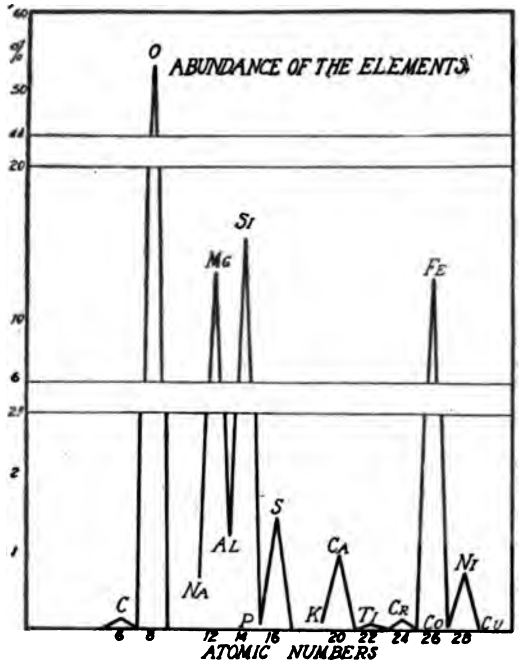
where ϵ represents a negative electron.

It is of extreme interest in this connection to note that Sir Ernest Rutherford has just announced that he has been able to bombard these atoms with extremely rapid moving alpha particles, and that he has been

able to drive hydrogen out of nitrogen atoms, but not out of either carbon or oxygen.

THE NEW PERIODIC SYSTEM OF THE ATOMIC NUCLEI

The *ordinary* periodic system, when put in a graphic form, as has been done by Crookes and more correctly by Soddy, and by Harkins and Hall, is a graphic expression of the ar-



Percentage by Atoms
Atomic Number

FIG. 1. The Periodic Variation in the Abundance of the Elements as the result of Atomic Evolution. The data are given for 350 stone and 10 iron meteorites, but the relations are true for meteorites in general. Note that *ten* elements of even atomic number makes up 97.59 per cent. of the meteorites, and *seven* odd-numbered elements, 2.41 per cent., or 100 per cent. in all. Elements of atomic number greater than 29 are present only in traces.

rangement of the planetary electrons. The *new* periodic system of the atomic nuclei was discovered by me five years ago in the following way. I reasoned that if the nuclei of the even numbered atoms are built of helium nuclei alone, while those of odd atomic number contain hydrogen nuclei in addition, that there should be a considerable difference in stability between the two classes of nuclei. I also told my students, before making any further study, that the even numbered atoms would prove to be more stable than the odd numbered.

Now there is, unfortunately, no known method of testing directly the stability of the lighter atoms, but it seemed a reasonable hypothesis that if the atomic nuclei had ever been built up, that in general the most stable nuclei would be formed in the greatest abundance. An investigation brought forth the following facts:

1. The *atoms of the even numbered or helium series* are *127 times more abundant* in the iron meteorites than the atoms of the helium-hydrogen or odd numbered series.
2. In the stone meteorites they are 47 times more abundant.
3. In the surface of the earth the even numbered atoms are about 10 times more abundant than the odd numbered.
4. The even numbered rare earth elements are much more abundant than the odd numbered.
5. In the meteorites every even numbered element is much more abundant than the two adjacent odd numbered elements.
6. All of the seven most abundant elements in the meteorites are even numbered, and these seven elements alone make up 98.6 per cent. of all of the material of the meteorites.

Thus the periodicity of this system is from even to odd, or the periods are two atomic species in length, while in the Mendeléeff system the periods are 2, 8, 18, and 32 elements in length. Dr. Norris F. Hall, of Harvard University, has pointed out that both the isotopic complexity and the number of predominant radiators in a pleiad, follow just this periodic variation.

THE STABILITY OF THE NUCLEI OF ATOMS

The most stable nuclei seem to be those of oxygen, magnesium, silicon, iron, all of them even numbered elements of low atomic number (except that as has been stated the helium nucleus is probably extremely more stable than any of these).

The atoms whose nuclei carry 28 or less positive charges are much more stable than those of higher atomic number. This is illustrated by the relative abundance of such elements as represented by the following table:

TABLE II

Proportion in Various Materials of the Elements of Low Atomic Numbers

Material	Percentage of Elements with Atomic Numbers 1–29	30–92
Meteorites as a whole	99.99	0.01
Stone meteorites	99.98	0.01
Iron meteorites	100.00	0.0
Igneous rocks	99.85	0.15
Shale	99.95	0.05
Sandstone	99.95	0.15
Lithosphere	99.85	0.15

When there are several varieties of atomic nuclei all carrying the same positive charge, as is the case with lead, with 82 positive charges on the nucleus, the nuclei differ in stability, but the complete atoms do not differ in their chemical properties nor in their spectrum. This has been shown very beautifully by Soddy, by Merton, and by Richards and Baxter, but most accurately by Dr. Aronberg, who worked at my suggestion. Two isotopes may have practically the same atomic weights, and differ only in the stability of their nuclei, as I pointed out four years ago.

THE BUILDING OF ATOM NUCLEI AGAIN

Let us now pay attention to the building of nuclei of even numbered charge, since the time is not sufficient to consider those of odd number also. Three, four, five, six, seven, eight or ten alpha particles may unite to form the nucleus of a complex atom, but two alpha particles alone, or more than ten alone, do not make a stable system.

In all heavier atoms there are some alpha particles which are bound on by two negative electrons. Thus the sulphur nucleus is a compound of 8 alpha particles alone, while the argon nucleus contains 10 alpha particles and two negative binding electrons. It is the presence of an extra alpha particle in the argon nucleus which makes its atomic weight higher than that of potassium.

The number of binding electrons does not increase to 4 until element 32 (germanium) is reached, but rises to 26 in the thorium atom. *It is these binding electrons which are given off in the beta disintegrations of the radioactive elements,* and if time permitted it could be shown that this disintegration is exactly in accord with the system of structure proposed for the nuclei of the lighter atoms. For example a radioactive atom may lose five alpha particles in direct succession, but never more than two of the binding electrons. Furthermore, if it loses a single binding electron it always loses a second one, but not more than two, which indicates that, corresponding to our theory, such binding electrons are associated in pairs.

The principal difficulty to be encountered in the artificial disintegration of atoms, that is, in the disintegration of their nuclei, is that of getting sufficient energy into such a small volume as that of a nucleus. In the building of atoms there is the additional difficulty of securing the proper arrangement of the alpha particles to give stability.[3]

WILLIAM D. HARKINS
UNIVERSITY OF CHICAGO

THE DISRUPTION OF ATOMS BY ALPHA RAYS

RECENTLY under the modest title "An Anomalous Effect in Nitrogen,"[1] Rutherford reported the remarkable discovery that when nitrogen molecules are bombarded by alpha rays, penetrating rays with a range of 28 cm. in air are produced which are certainly lighter than nitrogen atoms and which are probably

[3] The details of the system of atom building presented here may be found in the following references: *Journal of the American Chemical Society,* 37, 1367–1421, 1915, 38, 186–214, 1916, 39, 856–879, 1917; 41, 970–992, 1919. *Phil. Mag.,* 30, 723–734, 1915. SCIENCE, N. S., 46, 419–427, 443–448, 1917. *Proc. National Academy of Sciences,* 1, 276, 1915; 2, 216–224, 1916.

[1] *Phil. Mag.,* 37, 581–87, June, 1919; *cf.* SCIENCE, 50, 472, November 21, 1919.

hydrogen rays. His experiments furnish conclusive evidence that by this bombardment, nitrogen atoms may be disrupted and thus transformed or transmuted.

In the paper preceding the one just mentioned, Rutherford describes other secondary rays produced by alpha ray bombardment in both nitrogen and oxygen, which have a range in air of 9 cm. instead of 28 cm. These rays, he states, are presumably swift, singly charged nitrogen and oxygen atoms, respectively. The purpose of this note is merely to point out that their nature may be more interesting than their discoverer suggests.

The conclusion that they may be singly charged atomic rays is based on the fact that the computed ranges for such rays, 9.3 cm. the same as the observed ranges, 9 cm. in each case, whereas doubly charged atomic rays would be expected to have only one fourth these ranges. But the agreement is not very convincing, and there are other reasons for doubting the correctness of the hypothesis.

The alpha-ray experiments practically force us to accept the nuclear atom. In the case of such an atom, is it possible that a singly charged nitrogen ray may be produced as a result of a close collision between an alpha ray and a nitrogen nucleus? I think not; for since a singly charged nitrogen atom is a nucleus with six orbit electrons attached, a singly charged nitrogen ray could be produced only if each of the electrons as well as the nucleus were acted upon by the relatively large force required to give it a speed of about 10^9 cm./sec. in less than 10^{-18} sec. It can easily be computed that the field of the nucleus is insufficient to hold the electrons under these circumstances. Therefore, unless we postulate a stability which ionization phenomena seem to disprove, we must conclude that after such collisions, the orbit electrons are left behind. Moreover, even if singly charged rays were shot out, it is difficult to believe that most of the orbit electrons would not soon be detached as a result of the passage of the rays through many atoms. In other words, various experiments have given us a conception of the structure of atoms which makes it highly improbable that singly charged nitrogen rays would be produced as a result of bombardment by alpha rays.

Now the secondary nitrogen rays can not be multiply charged nitrogen atoms or nuclei, for such rays would have too short a range. And they can not be hydrogen rays because the scintillations they produce are too bright. Therefore they must be fragments of nitrogen nuclei which are larger than hydrogen nuclei. Rutherford has proved, as stated above, that nitrogen nuclei can be disrupted by alpha rays. If we suppose, as seems probable, that the nitrogen nucleus is made up of hydrogen and helium nuclei, then the disruption of the nucleus would be expected to result in both hydrogen and helium rays. It is therefore possible that *the less penetrating secondary rays observed by Rutherford when nitrogen is bombarded are alpha rays produced by the disruption of nitrogen nuclei.* The similar rays observed with oxygen may also be secondary alpha rays originating in disrupted oxygen nuclei. The fact that the scintillations produced by these rays are much like those due to alpha rays of the same range supports this suggestion.

But how is it possible for the range of the secondary alpha rays to be greater than that of the primary rays, in violation of the laws of mechanics? Just as the energy of alpha rays comes from the potential energy released when a radioactive atom becomes unstable, so the rays resulting from the disruption of a nitrogen nucleus may be expected to receive energy as a result of the mutual repulsion of the fragments. If the secondary rays are alpha rays, then, the effect of the bombarding alpha rays must be to make the nuclei unstable, producing an *artificial radioactivity.*

It is believed that the difficulty of explaining why so many of the secondary rays travel in the direction of the bombarding rays is no greater from this point of view than from the other.

It will be extremely interesting to determine by deflection methods the mass and charge of these rays so as to decide whether they are in fact nuclear fragments. In this way we may

get definite evidence as to the fundamental structure of nuclei.

G. S. FULCHER

NATIONAL RESEARCH COUNCIL,
November 27, 1919

THE FESTSCHRIFT OF SVANTE ARRHENIUS[1]

Highly Honored Friend and Master:

Modern culture is perhaps best characterized by man's enlarging control over nature. But this has not been attained without an increased knowledge of the forces wherewith nature works. Through your now over thirty year old theory concerning force ions, you have made possible a deeper penetration into nature's own workshop than was formerly attainable. Concerning electrolytic phenomena, which your countryman Berzelius, with correct appreciation of their fundamental significance, so diligently studied, you have shed a wonderful light and you have thereby strengthened the foundations for the whole chemical knowledge and this not alone with respect to lifeless nature, but in equally high degree with respect to living nature. "Selten hat ein glücklicher Gedanke," once said W. Ostwald, who was himself the first to understand its meaning, "in so hohem Maasse Licht über weite und schwierige Gebiete geworfen, wie die von Arrhenius entwickelte Idee, dass die Elektrolyte in wässriger Lösung in ihre Ionen dissoziirt sind."

Briefly stated, you have with your theory stirred up a culture wave within the scientific and technical world which will sweep forward through time and thereby you have also become one of our time's culture bearers.

If one may believe Xenophon, Socrates used to advise those who sought help concerning their difficulties, to carry out that which they knew should happen, as he deemed best; but otherwise he advised that they ought to have recourse to the art of divination, hearken to the inner spirit, which should give them directions. Thus does also the scientist. When theory is clear he follows it in the best manner, but when the opposite is true, even he must resort to divination; and a wonderful prophet you have been. You seem once to have had one of these dreams which, as is said, sometimes goes ahead and anticipates the judgment of clear daylight.

Among the friends of Socrates was also Aristippus. It is related concerning him that he like the rest of beauty-loving Athens was sorely smitten by the handsome Lais. One of his friends expressed surprise over this that even he, the sober philosopher, should have been caught in her net. Aristippus, who was no friend of superfluous words, answered merely: Caught, by no means imprisoned. Thus you can also say concerning the ions. You have bound them to reality by unbreakable bonds, but your spirit for research has not let itself be bound to merely this field of labor.

When one wishes to scale the Alps he comes first to the warm, peaceful valleys where living nature steps forward to meet him in all her beauty, and there one might wish to dwell his whole life were not the view so limited. One climbs higher and higher and the horizon widens, but the air becomes sharper, flowers and foliage disappear, and at last one is met by only the cold blasts of snow and ice. Everything would speak of death if in this indescribable silence, in this boundless heaven there was not found something which spoke of the unending, the everlasting. A similar road you have trodden through the research world. You have with your keen vision imagined yourself to see the whole universe's unending space and everlasting time, how the worlds therein develop and dissolve, how all is a *perpetuum mobile;* yes, you have with the camera's help found how the seeds of life sail through the ether ocean from world to world. Such are the wide-embracing views you have given us.

To celebrate the day when you with yet unbroken power and undiminished interest enter upon your seventh decennium, we have with admiration for your research work and in devoted friendship for your person dedicated to you this writing.

[1] Translation of Preface of "Festskrift utgiven Till Svante Arrhenius' 60–Arsdag den 19 Februari, 1919."

THE DEATH OF LADY ALLARDYCE

THE name of Constance Allardyce, wife of Sir William Allardyce, governor of the Bahama Islands, will not go unrecorded in the annals of science. Before appointment to the Bahamas and after eight years of diplomatic service in the Fiji Islands, Sir William Allardyce was governor of the Falkland Islands and it was during their eleven years on this station that Mrs. Allardyce (as she then was) showed her helpful interest in scientific undertakings. The writer gratefully recalls her enthusiastic aid in assembling the fossils of the rich and remarkable Devonian fauna of the islands when there was no one else to help and where there was no notion of what was wanted. Responding to an appeal for aid made to the governor, she took up the search, diligently acquainted herself with what was to be looked for, aroused the curiosity and interest of the people of the nearer and farther islands even to the shepherds scattered over those seventy-five bits of archipelago, established collecting stations here and there among them and so brought together scientific material of great worth. She kept alive this interest during the years of her residence, extended it into other lines and eventually established the Falkland Islands Museum at Stanley, the southernmost museum of the world and probably the most remote scientific outpost of the British Empire. It may be well said that the collections gathered by Mrs. Allardyce are the basis of pretty much all that we know to-day of the ancient life of those islands and her name and services have been permanently interwoven in the geological story of the Falkland Islands.

JOHN M. CLARKE

SCIENTIFIC EVENTS

GIFT TO THE MUSEUM OF VERTEBRATE ZOOLOGY OF THE UNIVERSITY OF CALIFORNIA

Two hundred thousand dollars have been given by Miss Annie M. Alexander to the University of California for the permanent support of the California Museum of Vertebrate Zoology. Dr. Joseph Grinnell, associate professor of zoology and director of the museum makes the following statement:

> The work of the California Museum of Vertebrate Zoology was formally inaugurated on March 23, 1908, when Miss Annie M. Alexander, then of Oakland, upon her own initiative entered into an agreement with the university by which she promised support for a period of seven years. It has now been nearly twelve years since the museum was thus founded by Miss Alexander, and she has continued her support in increasing measure, until now, by her endowment, the continuance of the museum is insured for all time.
>
> The collections of the museum comprise at the present time a total of 70,833 specimens, consisting of 30,519 mammals, 31,347 birds, 1,804 birds' nests and eggs, 7,163 reptiles and amphibians. In addition there are some 17,000 privately owned specimens in the various groups, on deposit here. All of this material is freely available for study by any responsible natural history student, here and elsewhere. A system of loaning is in operation by which series of specimens are sent to any investigator wherever he may be located. The value of the museum's possessions in the way of specimens and facts can not help but increase in direct ratio to the extent in which these are used. The free loaning of material in vogue does away with any grounds for the complaint sometimes made against museums, that they are merely "cold storage" institutions whose aims are only to gather and hoard. A total of 9,713 specimens has been loaned, during the past eleven years, to 128 different institutions or individuals. Investigators in Washington City alone have had sent to them for examination 2,642 of the museum's mammals and birds.

The staff of the museum at the present time consists of Dr. Joseph Grinnell, director; Harry S. Swarth, curator of birds; J. Eugene Law, curator in osteology; Tracy I. Storer, field naturalist; Joseph Dixon, economic mammalogist; Harold C. Bryant, economic ornithologist; Margaret W. Wythe, general assistant, and Richard Hunt, assistant curator of birds.

LOSS OF GEOLOGISTS BY THE NATIONAL SURVEY

IN his annual report the director of the United States Geological Survey writes:

The fact that there have been 77 resignations from the scientific force of the United States Geological Survey, Department of the Interior, during the last year—17 per cent. of the force—suggests inadequacy of compensation, and the percentage of resignations in the clerical and non-scientific force was even larger. This statement of course does not include separations to enter military service. The largest inroad upon the Geological Survey efficiency comes from the oil companies; the final result of the pioneer work of the federal geologists in applying geologic methods to the search of oil and gas is that a large proportion of the leading oil geologists the world over are United States Geological Survey graduates. Indeed, the future decline in popularity of the Geological Survey as a recruiting station for oil-company personnel will be due simply to the fact that the experienced oil geologists who remain in the government service are from personal preference immune to outside offers.

The relations between government salaries and outside salaries of geologists has been definitely determined in a compilation of the records of 29 geologists who left government service after receiving an average salary of $2,271. The average initial salary of these men in private employ was $5,121, and after about two years of average service this compensation averaged $7,804, and eight of these geologists receive $10,000 or more. The disparity is even greater if consideration is given to the large financial returns from investments made by the private geologists in connection with their professional work, a privilege properly denied by statute to the official geologist.

That the value of these men as specialists and consulting geologists is far greater to the country at large than to private corporations is undeniable. Furthermore, it is important to note that most of these geologists had persisted to the limit of endurance with a magnificent spirit based on their love of scientific research and their desire to contribute to the sum of geologic knowledge. Most of them have been forced out of the service by sheer financial necessity. Unless adequate measures are taken to ameliorate the situation, the geologic staff is destined to suffer far greater deterioration of morale and depletion in its ablest, most responsible, most experienced and most valuable members. The Geological Survey is passing into a stage when, with greater need than ever for systematic geologic work in the country, it is ceasing to be attractive to the young men of greatest ability, training and promise. This situation deserves prompt and effective remedy, for it threatens most seriously to cripple this branch of the public service.

REDUCED RAILWAY FARES TO MEETINGS OF SCIENTIFIC AND LEARNED SOCIETIES

MR. FREDERIC S. HAZARD, assistant secretary of the American Association for the Advancement of Science, and representatives of the American Historical Association and other societies meeting at Cleveland have been in correspondence with the U. S. Railway Administration in regard to reduced fares which have not been granted. In their letter they say:

We respectfully submit that this narrow interpretation of the term "educational" constitutes a discrimination against the learned and scientific societies of the country which is prejudicial not only to their interests but to the general cause of education in America viewed in any comprehensive way.

It is well known that these societies are not in any sense political, commercial or money-making, but are solely scientific and educational. Their membership, especially that part of it which usually attends their meetings, is largely composed of teachers in universities, colleges and the public schools and of men and women engaged in scientific research. To these members the benefit derived from annual contact with their colleagues is of no small importance, and is reflected in their work in the classroom or laboratory. To the public-school teachers the meetings afford almost the only opportunity of coming into close touch with the leading specialists and advanced teachers in their respective fields. It is impossible to overestimate the advantage to the educational system of the country that has come from these annual gatherings of teachers and investigators; from the point of view of content it is certainly as important as is, from the point of view of method and administration the advantage that has been gained from the meetings of the purely pedagogical societies.

But it should be emphasized that the scientific societies have always laid stress upon the pedagogical aspects of their work. They constantly provide in their meetings for special sessions devoted to the teaching of their various disciplines. Some of them have long maintained standing committees on teaching, and have published reports which have been adopted throughout the country as the basis

of school work in the respective subject. Furthermore, these societies have frequently been recognized as of public utility by the government. The Department of Agriculture, for example, grants special leave to its employees in order that they may attend the meetings of the American Association for the Advancement of Science. The War Department, to cite another instance, has detailed officers to attend the meetings of the American Historical Association and of the American Association for the Advancement of Science.

The assistant director of railroads writes:

In view of the arguments presented by you for favorable action it seems appropriate to set before you the considerations that prompted the government to grant reduced rates for conventions. It was a very serious question whether the government would be justified in putting them into effect at all. Past experience has shown that as a whole such reduced fares have operated to reduce railroad revenues and to increase the cost of transportation because the giving of them encouraged people who were planning to make business trips to adjust their trips so as to take advantage of the reduction. This resulted in diminishing the amount of travel, and consequently increasing its cost, prior to the time such reduced fares were put into effect, and in congesting the travel during the time such reduced fares were in effect, thereby increasing the cost during that period also. In the present time, when railroad costs just as all other industrial costs are exceedingly high, it seemed clear that the government would not be justified in putting into effect reduced rates which would result in an important diminution in the net earnings received from the business. On the other hand, it was deemed desirable to encourage the attendance at certain conventions and to afford to persons who wished to attend them and who would be unable to go except for reduced rates the opportunity to do so. The classes of conventions decided upon were religious, charitable, fraternal, military and educational. This classification was adopted with a full realization of the difficulties which would result and that the action might be considered an arbitrary one. It was felt, however, that it was based upon sound grounds and, under all the circumstances, is consistent and defensible. It was plain that the term "educational" taken in its broad sense could be construed to cover a very large number of conventions. For example, those of doctors, lawyers, dentists, business colleges, etc. It was, therefore, necessary to restrict its definition, and this was done by confining it to those conventions having to do with elementary education, such as meetings of school teachers, and among these meetings was included the National Educational Association.

THE ST. LOUIS MEETINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE announcement sent out from the office of the permanent secretary of the American Association for the Advancement of Science says:

The American Association for the Advancement of Science and many national scientific societies affiliated with it will hold its seventy-second meeting in St Louis, from December 29, 1919, to January 3, 1920, under the auspices of the educational institutions of the city. All meetings will be held in the Soldan High School, corner Union Boulevard and Kensington Avenue. Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, will preside. The address of the retiring president will be given by Dr. John Merle Coulter, of the University of Chicago, at the opening general session of the association, and will be followed by an informal reception to members of the association and of the affiliated societies.

This seventy-second meeting of the American Association, which was established in 1848, will be marked by the importance of its program and by the increased interest manifested in all branches of the natural and the applied sciences. It will embrace a program devoted very largely to definite working problems of reconstruction. When the association last met in St. Louis, fifteen years ago, the membership of the association was only 4,000. The membership of the association at present numbers nearly 15,000 and the coming meeting will be one of the most important gatherings of scientific men hitherto held in this country or elsewhere.

The occasion should be taken to strengthen the association and its work in the central states, which have in recent years assumed such leadership in scientific research. We may be sure that the scientific men of Washington University and the city of St. Louis will do their part. It would be well if the meetings might be celebrated by affiliation with the association of the strong state and city academies of the central states and the organization of a central branch of the association on the lines that have proved so successful on the Pacific coast.

SCIENTIFIC NOTES AND NEWS

The annual meeting of the New York Academy of Sciences was held on Monday evening, December 15, at which the following officers were elected. *President*, Dr. Edward L. Thorndike; *Vice-presidents*, Dr. C. L. Bristol, Dr. Isaiah Bowman, Dr. W. J. Giles, Dr. R. S. Woodworth; *Recording Secretary*, Dr. R. W. Tower; *Corresponding Secretary*, Dr. Henry E. Crampton, *Treasurer*, Mr. John Tatlock. The retiring President Dr. Ernest E. Smith delivered an address on "Applied Science and the War," after which two interesting and illustrated talks were given by Professor Douglas W. Johnson on "A Geographer at the Front and at the Peace Conference" and Professor Henry E. Crampton on "Tahiti and the South Seas."

The president of Northwestern University at Evanston, Ill., and the board of control of the Michigan College of Mines at Houghton, Mich., have each received from the chief of the Bureau of Ordnance of the U. S. Navy a formal letter of appreciation thanking them for permitting the time and experience of Dr. John F. Hayford, director of the College of Engineering at the former institution, and of Dr. F. W. McNair, president of the College of Mines, to be devoted to the service of the government and in particular to problems of naval gunnery. They were on the staff of the U. S. Bureau of Standards during the war and with Dr. Lyman J. Briggs, chief of the wind tunnel at that bureau worked on problems concerning the large guns of the navy. For purposes of test and demonstration they accompanied the Pacific Fleet on its recent voyage from Hampton Roads to the California coast, attached to the U. S. S. *Mississippi*. The letter of the chief of the Bureau of Ordnance states that the work of these scientific men has resulted in a considerable advance in the gunnery of the U. S. Navy.

The gold medal of the Society for the Protection of Wild Life has been presented to Dr. John M. Clarke, New York state geologist and director of the State Museum at Albany.

At its meeting held December 10, 1919, the Rumford Committee of the American Academy of Arts and Sciences appropriated the sum of three hundred dollars to Dr. Frederick G. Keyes, of the Massachusetts Institute of Technology, in aid of his research on the heats of neutralization at different temperatures.

Sir Donald MacAlister, president of the British General Medical Council, has been invested by President Poincaré with the Cross of Commander of the Legion of Honour.

The University of Leeds has conferred the following honorary degrees: D.Sc.: Admiral Sir Henry Jackson, First Sea Lord, 1915–1916; Surgeon-General Sir Alfred Keogh; Sir Almroth Wright; Professor W H.. Bragg, and Mr. J. G. Baker.

Dr. J. E. Stead has been nominated by the council of the British Iron and Steel Institute as president for next year in succession to Mr. Eugene Schneider.

W. F. Rudd, of the department of chemistry at the Medical College of Virginia, has been elected president of the American Conference of Pharmaceutical Faculties.

Mr. H. A. Nelson, formerly of the Bureau of Standards, is now with the New Jersey Zinc Company.

Dr. N. F. Drake, head of the departments of geology and mining engineering at the University of Arkansas, will sail on December 25 from Vancouver for China, where he will do research work until April of 1920.

Professor W. A. Noyes, of the University of Illinois, delivered an address on a "Career in Research" at the fiftieth meeting of the Medical Research Club of the Universtiy of Illinois held on December 9."

Dr. G. F. Loughlin, of the Geological Survey, is giving a course lecture on metalliferous geology at the Massachusetts Institute of Technology, temporarily filling the place of Professor Waldemar

The Thomas Vicary Lecture of the Royal College of Surgeons of England was delivered by Sir John Tweedy on December 3, on "The surgical tradition." The Bradshaw Lecture before the same College was delivered by Sir

Charles A. Ballance, on December 11 on "The surgery of the heart."

AT a meeting of the Royal Aeronautical Society at the Royal Society of Arts, on November 10, Dr. C. A. Swan gave a lecture on some physical and psychical effects of altitude.

ACCORDING to the Madrid correspondent of the London *Times* an International Conference of the Mediterranean has been held in that city. The principal object of the conference was to discuss the organization of a permanent central office of fisheries to be opened at Monaco. This office will be formed of delegates from each Mediterranean nation, and will allot and centralize the fisheries research work to be undertaken in the spring and autumn campaign, lasting from April 1 to May 31 and from October 1 to November 30 of each year, by the countries interested. The results of the work done will be published by the central office in a bulletin printed in the French, Spanish, Italian and English languages. Four ships will be at the disposal of the central office, the *Hirondelle II.* belonging to the Prince of Monaco, the specially built Italian ship *Tremitti,* and a French and a Spanish ship not yet detailed. The central office will coördinate the work hitherto carried out by each nation separately, with a view to developing the fishing industry by the scientific investigation of the habits of edible fishes, their migration and spawning periods. The central office will also coördinate the work of exploring the bottom of the Mediterranean and the study of its surface and under currents, about which very little is known at present, and the importance of which in the Straits of Gibraltar and in the Dardanelles is very great. Without waiting for the spring campaign the Italian government is starting work next month in the Dardanelles, at which two Spanish scientific men have been invited to assist. The first work of the spring campaign will probably be in the Straits of Gibraltar.

AN oil shale laboratory, with an initial expenditure of at least $20,000, is to be established at the University of Colorado at Boulder immediately by the United States Bureau of Mines and the state of Colorado. The laboratory is to be operated under the department of mechanical engineering, and will be under the direction of Professor John A. Hunter. The department at present maintains an oil laboratory which can be utilized to some extent in the new work. To house the machinery and equipment which will be necessary for the experimental treatment of shales a separate building will be erected. The Federal Bureau of Mines will send men to the university to look after the government's end of the work, and it is expected that eventually the department will grow to the magnitude of the radium research laboratory established several years ago at the School of Mines at Golden. The last named work at present requires the services of a dozen men and occupies a three-story building. The new department is designed for the research and experimentation consideration necessary for the exploitation of the huge deposits of oil shales in western Colorado and Utah on a commercial basis.

THE board of directors of the American Electrochemical Society has approved and ordered sent to members of Congress and the officials of the War Department the following resolution concerning the Chemical Warfare Service:

WHEREAS, The development of science and research is of paramount importance not only to the military establishment of the United States, but to the welfare and security of the entire nation; and

WHEREAS, The bill introduced into Congress for the reorganization of the Army (Senate 2171—66th Congress) is not only clearly destructive of the Chemical Warfare Service, but is so drawn as to belittle all scientific and technical work in the Army and make it subordinate to the unscientifically trained officer:

Therefore, be it Resolved, That the American Electrochemical Society urges strongly that any legislation for the reorganization of the Army shall provide for the continuing of the Chemical Warfare Service as a separate staff bureau as at present; shall provide for the commissioning of staff officers in the corps and departments in which they are to serve; and shall in general accord to the technical man full recognition and opportunity

throughout every grade and department of the military establishment.

ARTHUR D. LITTLE, Inc., chemists and engineers, Cambridge, Mass., through its Information Department, is planning a series of Bibliographic Studies, to be circulated among the public, university and special libraries of the United States, and the firms and individuals interested in the various studies. Those in course of preparation are: Chemical Warfare; Alcohol from Waste Sulfite Liquors; Industrial Research; The Automobile and Tractor at the Front; The Electric Furnace; Industrial Laboratories; Molasses; The Chemical Action of Light; Woods and Fibers used as Paper Making Materials. Copies of the first three of them are ready and may be had upon request.

THE REV. DR. WILLIAM T. MANNING, rector of Trinity Parish, New York, offered a resolution in the House of Deputies of the Episcopal Church at the recent general convention in Detroit, providing for the appointment of a committee of three bishops, three presbyters, and three laymen "to consider the fuller recognition of the ministry of healing in the Church and the need of its revival under proper sanctions and safeguards." The resolution was unanimously adopted and sent to the House of Bishops for concurrence. Dr. Manning, who is a trustee of Columbia University, has been interested in an English faith healer who has held clinics at Trinity Church.

IN connection with the statement issued by the United States Public Health Service in regard to the probable return of the influenza epidemic this year, it is announced that the laboratories of Harvard University have been chosen to conduct exhaustive research into the causes, effects and complications of the disease, together with their prevention and cure. Dean David L. Edsall, of the Harvard Medical School announces that a large corporation which suffered losses as a result of the epidemic last year has given $50,000, the greater portion of which will be used by Dr. Milton Joseph Rosenau, professor of preventive medicine and hygiene of the Harvard Medical School and a corps of assistants to carry on the exhaustive studies and research to discover some means to prevent future outbreaks of the epidemic.

IT is stated in *Nature* that under the will of the late Dr. Joseph Wiglesworth, his ornithological library passes by bequest to the University of Bristol. This library of more than 1,000 volumes, including finely-bound copies of the works of Gould, Seebohm, Dresser, Lilford, Levaillant and other leading authorities, is probably one of the best in England. It will be housed in a separate room in the new university buildings, and will be kept up to date. Dr. Wiglesworth gave the residue of his estate to the university after his widow's death for the furnishing and maintenance of this special library.

UNIVERSITY AND EDUCATIONAL NEWS

AT the recent meeting of the Yale Corporation several gifts were announced. Mr. Austin C. Dunham, of Hartford, has given $64,000 to cover the amount advanced by the Sheffield trustees in constructing the electrical engineering building of the Sheffield Scientific School. The building is to be known hereafter as the Dunham Laboratory of Electrical Engineering. By the death of the widow of Dr. Levi Shoemaker, of Wilkes-Barre, property valued at about $200,000 goes to the university for the general endowment of the School of Medicine. A fund of $6,000 has been received from Edith Meacham Hitchcock and Standish Meacham of Cincinnati, to establish a scholarship in the Sheffield Scientific School in memory of Robert Douglas Meacham of the class of 1907 of the Scientific School.

THE sum of five thousand dollars from a "friend of the university" has been received by the University of California for the support of special research work in the department of paleontology during the year 1920.

DR. ROSWELL P. ANGIER, professor of psychology at Yale University, has been appointed to the newly established deanship of the common freshman year.

AT the University of Manchester the following appointments have been made: A. G. Ogilvie, reader in geography; J. MacMurray, lecturer in philosophy; A. Gardner and R. L. Newall, demonstrators in anatomy.

DISCUSSION AND CORRESPONDENCE

A PROPOSAL OF TWO NEW MIOCENE FORMATIONAL NAMES

IN the summer of 1916, I organized, with the help and encouragement of Professor G. D. Harris, a paleontological expedition to Santo Domingo, with the hope of differentiating the Yaqui Valley Tertiary beds. These had been indiscriminately called Miocene by Professor Gabb in 1874, and in recent years referred by Dr. Dall and Dr. Pilsbry to the Oligocene. The members of the exploratory party were Mr. Karl Paterson Schmidt, Mr. Axel Olsson and the writer, the actual collecting being very efficiently done by the two gentlemen. The collections were chiefly made from bluffs along tributary streams flowing northward through the Samba Hills into the Rio Yaqui. Our most important collections and sections were made on the Rio Cana near Caimito, the Rio Gurabo near Los Quemados, and the Rio Mao near Cercado.

While proceeding up the Rio Gurabo, Mr. Schmidt and Mr. Olsson observed a sudden change in the fauna of the bluffs near Los Quemados. They felt confident that this indicated a different formation from that further down the stream.

A careful and detailed study of the mollusca we had collected was made by the writer and the presence of two formations verified, the results being published in 1917.[1] I then designated these two formations by index fossil names, calling them the Lower or *Aphera islacolonis formation,* and the Upper or *Sconsia lævigata* formation.[2] This was to contrast them with the *Orthaulax inornatus* formation. I referred the *Orthaulax* formation to the Upper Oligocene of Tampa; the Lower or *Aphera* formation to the Lower Miocene; and the Upper or *Sconsia* formation to the Middle Miocene.

It now, however, seems desirable to apply geographical names, in conformity with modern stratigraphical nomenclature, to these formations. I therefore propose for the Upper or *Sconsia lævigata* formation of my 1917 report, the name Gurabo Formation. This includes primarily our Zones A to F on Rio Gurabo near Los Quemados and our Bluff 1 on Rio Mao near Cercado. For the Lower or *Aphera islacolonis* formation of my 1917 report I now propose the name Cercado Formation. This includes primarily our Bluffs 2 and 3 on Rio Mao near Cercado, our Zones H and I on Rio Cana near Caimito, and our Zone G on Rio Gurabo near Los Quemados. The Cercado formation also includes a set of fossils from Bulla river loaned to me for study by the American Museum of Natural History.

CARLOTTA J. MAURY

PALEONTOLOGICAL LABORATORY,
CORNELL UNIVERSITY

[1] Bulletins American Paleontology, Nos. 29 and 30.

[2] *Bull. Amer. Pal.*, No. 30, p. 40, and Correlation Table facing p. 44.

SNOW DOUGHNUTS

TO THE EDITOR OF SCIENCE: To the descriptions of snow-rollers which have appeared in recent numbers of your journal may the following be added?

During the winter of 1916–17 a heavy snow fell in Monongalia county, West Virginia, which provided for a short period an opportunity for travel in sleighs. The snow drifted to depths of several feet in places and formed along some roadside fences steep-walled drifts which were, here and there, overhanging at their tops. The writer traveled in a sleigh for several miles along the side of Chestnut Ridge, the westernmost of the Allegheny Mountain ridges in this region. The snow was at this time fresh and unpacked.

At the foot of these steep-walled drifts and also lying part way down their slopes were, in many places, numbers of small snow rings resembling doughnuts in appearance. The rings were a little slenderer than the average

doughnut and the writer's impression is that they were from two to four inches in diameter and about a half inch in thickness. Each had left behind it a track in the snow which led from the foot of the overhanging portion of the drift wall down its side into or nearly to the road. A few curved, columnar pieces of snow were also found which had fallen from the top of the drift and had rolled down the side without forming rings.

It was evident that the rings and columnar pieces had been formed from small tongues of snow which had been built out over the steep side of the drift at its top by the wind. These tongues had separated from the snow wall first at the top and had bowed themselves over until their free ends nearly or quite touched the snow at their bases with the result that they broke away and rolled down the bank.

As in the case of the attainment of large size by the "rolls" described by Karl M. Dallenbach in your issue of October 17, so in this instance the completion of the ring form was a matter of balance during the process of bending forward and rolling down since a few fragments had broken away and rolled on their sides without having attained the ring form.

While the wind seems in this case to have operated in building out the tongues of snow until they became too heavy to maintain their equilibrium it was probably not involved in the rolling process which seems to have been due altogether to gravitational attraction.

W. Armstrong Price
West Virginia Geological Survey,
Morgantown, West Virginia

VARIATION OF FISHES ACCORDING TO LATITUDE

To the Editor of Science: In the number of Science for April 4, Professor Starr Jordan discusses the generalization that in certain families of fishes species living in cold waters have a large number of vertebræ, while the related ones of warm waters have a small number. He interprets this as being the result of a general phylogenetic process which is favored either in warm or in cold water, depending upon whether the large or the small number of vertebræ is considered as more primitive. He has attempted to determine which is the more primitive by investigating the ontogeny of the metameres in *Sebastodes*, but has failed in this, because, as seems to be generally the case, the number of metameres characteristic of the adult is attained at a very early stage.

We would refer to the fact that such variations in number of vertebræ with temperature occur within the limits of a single species, as Heincke[1] has shown for *Clupea harengus*. Both sea-herring and coast-herring show a decrease in (1) number of vertebræ, (2) breadth of skull, (3) number of keeled scales, and (4) length of body, as one goes from the open ocean into the Baltic. We would suggest that this shows the adaptation of the large type with many vertebræ to water of great density (very saline and cold) during the critical and sensitive early stages of development, and of the small type with few vertebræ to water of low density (brackish and warm); that is, that certain characteristics connected with a large number of vertebræ make the young of the large type develop successfully in water of high density and that other characteristics connected with a small number of vertebræ make the young of the small type develop successfully in water of low density. The adults are comparatively hardy and able to seek water of suitable density. In the species *Hippoglossoides platessoides*, Collett[2] has shown that northern specimens have more rays in the dorsal and anal fins than have southern specimens. We have not been able to find that the individuals of this species on this side of the Atlantic have the numbers of fin rays varying according to latitude. Nor does the variation of fin rays correspond with the temperature or density of the bottom water in which the adults live. There are however indications that it corresponds with the density of the surface water in which the

1 "The Natural History of the Herring," 17th Ann. Rep. Fishery Board for Scotland, 1899, p. 283.

2 "Fishes," Norweg. North-Atlant. Expedn., Zoology, Vol. III., 1880, p. 148.

eggs develop. A fruitful field for investigation is open in this direction.

A. G. HUNTSMAN

CONSTANTS AND VARIABLES IN BIOLOGY

TO THE EDITOR OF SCIENCE: I have read Mr. Frank J. Kelly's letter on the substitutes for the words "homozygous and heterozygous." His argument appeals to me very particularly because we are constantly confronted with variously constructed new terms to express scientific theories. It seems to me it is by far best to give a special and restricted meaning to the ordinary words of the English language as is done in mathematics.

In this science the word "constant" is used to express a stable quantity and "variable" one that is subject to change. Why could not these two terms be bodily lifted from mathematical language into biological? The second term would quite adequately cover what Mr. Kelly calls "inconstant form."

J. R. DE LA TORRE BUENO

SCIENTIFIC BOOKS

Animal Parasites and Human Disease. By ASA C. CHANDLER, M.S., Ph.D., Instructor in Zoology, Oregon Agricultural College, Corvallis, Oregon. xiii + 570 pages. 6 × 9. 254 figures. Cloth, $4.50 net.

The work aims to present the subject of parasitology and especially its relations to the problems of human disease in such form as to make it attractive to the generally educated reader, and also useful to those less technically trained persons who have reason to utilize information in this field. The author's efforts have certainly achieved a good measure of success. His style is attractive and his presentation clear and reasonably complete. The work will be used by many who would not be inclined to refer to a more extended and more critical presentation of the subject.

After an introduction, outlining the significance of the subject and a discussion of parasitism in general, the first part of the work is devoted to a consideration of protozoa. These organisms have been grouped according to their systematic relationships. Under each heading, however, the particular organism is treated with reference to its significance in producing disease. The chapters included in this part are entitled: Introduction to Protozoa, Spirochætes, Leishman Bodies and Leishmaniasis, Trypanosomes and Sleeping Sickness, Intestinal Flagellates and Ciliates, Amebæ, Malaria, Other Sporozoa, and Obscure or Invisible Parasites.

This is the largest and certainly the most valuable part of the work, for it brings together a mass of material not readily available in this form in any other work. It points out in striking fashion the significance of recent discoveries concerning protozoa and disease. On the whole the treatment is well balanced and there are no important omissions. The author has included studies of recent date and perhaps has gone to the extreme in giving a place to discoveries so recent that their significance might well be considered doubtful, even if the observed facts are conceded to be correct. As an example of this may be cited the entry, in a note at the end of the chapter on spirochætes, of a discovery of one of these organisms in the kidney in cases of typhus and the comment that certain other bodies possibly are stages in the life history of the organism. One may reasonably doubt whether such conjectures regarding a complex and difficult field are really in place in a brief discussion intended to give the general reader clear and correct views of the present status of knowledge on these questions. It is only necessary to recall the number of organisms that have been at times supposed to be "causes" of certain diseases to see the questionable advisability of listing such suggestions before they have been thoroughly tested by other investigators.

Part II. on the Worms can not be regarded as equally successful. The chapters included in this part are entitled: Introduction to the "Worms," The Flukes, The Tapeworms, Hookworms, Other Intestinal Roundworms, Trichina Worms, Filiariæ and Their Allies, Leeches.

The material called for here is really better

worked up and better known and yet its presentation in this work leaves much to be desired. The author's discussion of the zoological significance of the term "Worms" is hardly on a level scientifically speaking with the work in other sections of the book. Furthermore it has no particular place in a treatise of this character where the parasitic organisms related to human diseases are the only ones under consideration. These are easily classified in certain generally recognized branches or subdivisions of other rank; they can be reasonably clearly defined without a discussion or even mention of those groups of uncertain relationships that make the subdivision of "worms" so difficult to handle. The introduction of this material serves also to confuse the student of health problems for it can hardly be intelligently handled by any one without considerable technical training in zoology. The general discussion of the significance of the parasites in this group is clearly inferior to that which has been printed in recent works like Braun or Fantham, Stephens and Theobald. The treatment of the separate subdivisions of this topic, while interesting and fairly complete, has not reached the standard set by the author in the first section of the work.

Part III. of the book is devoted to the Arthropods. After an introduction covering general features chapters are devoted to mites, ticks, bedbugs and their allies, lice, fleas, mosquitos and other blood-sucking flies, fly maggots and myiasis. The importance of these forms as agents in the transmission of diseases and their relations to specific maladies are clearly presented. The work will be a most convenient compendium despite the appearance of several recent more comprehensive works on medical entomology that cover in fact the same field as this section of Dr. Chandler's book.

It is difficult to agree with the author in his total elimination of references to those investigators who are responsible for the work outlined in the various parts of his book. While it may be true that extended references to original sources are out of place in so brief a presentation as his, yet it does injustice to the student if to no one else, that the author should present even a brief statement of the problem without any indication of the place in which the student interested can follow up the subject. I should not neglect to state that the author has included at the close of his book six pages of general references under the heading "Sources of Information." The list is very short and by virtue of the contractions employed might be difficult for some persons to use, while at the same time it is certainly unattractive in appearance on that account. Furthermore, there is no indication whatever of the significance of individual items beyond that contained in a very general subheading. In the opinion of the reviewer such a list is of very little use to the general student, and the same amount of space devoted to a citation of the major sources of information would have been of real value if the items had in one way or another been brought into definite connection with the specific discussions of the text.

The author's figures are not always particularly happy and some of them, such as Figs. 13 and 109, are little more than caricatures. It is difficult to believe that as good a scientific investigator as Dr. Chandler should have prepared a drawing like that represented in Fig. 120, where the size of the young trichinæ in the muscle fibers is apparently radically unlike the conditions as reported by many competent observers. Some of these little defects may be due to the rapidity with which the work was prepared. It is to be hoped that they can be corrected in a later edition. Many persons will find the book both interesting and useful, for it covers the field in a way not otherwise available.

Henry B. Ward

University of Illinois

THE TENNESSEE ACADEMY OF SCIENCE

The eighth annual meeting of the Tennessee Academy of Science was held on November 28, 1919, at George Peabody College for Teachers,

Nashville, Tenn., President L. C. Glenn presiding. The program of papers was as follows:

Memorial sketches of Dr. Brown Ayres and Professor Samuel M. Bain, by Dr. C. H. Gordon.

Annual address of the president, "Geography of the North Carolina-Tennessee boundary line," by Dr. L. C. Glenn.

"Recent oil and gas development work in Tennessee," by Wilbur A. Nelson.

"Luck," by Dr. F. B. Dresslar.

"The elimination of errors in a mental maze," by Professor Joseph Peterson.

"Archeology: new discoveries in the middle south," by W. E. Myer.

"Notes on the early history of the development of the mineral kingdom," by A. W. Evans.

"The feeding of the American army and some civilian applications," by Dr. Lucius P. Brown.

"Some entomological problems," by A. C. Morgan.

"Remarks on the orthoptera of Clarksville, Tenn.," by Henry Fox.

At the conclusion of the president's address a committee was appointed to recommend to the academy at its next meeting the adoption of a general name for the mountains of the Tennessee-North Carolina boundary line, taking into consideration all the different names that have been used and selecting the most authentic. This committee consists of Professor A. E. Parkins, of the department of geography, Peabody College; Dr. C. H. Gordon, of the department of geology, University of Tennessee, and Mr. Wilbur A. Nelson, state geologist of Tennessee.

The election of officers for the ensuing year resulted as follows: *President*, Dr. L. C. Glenn, Vanderbilt University, Nashville, Tenn.; *Vice-president*, Miss Jeanette M. King, Middle Tennessee State Normal School, Murfreesboro, Tenn.; *Editor*, Dr. C. H. Gordon, University of Tennessee, Knoxville, Tenn.; *Secretary-Treasurer*, Roscoe Nunn, U. S. Weather Bureau office, Nashville, Tenn.

Roscoe Nunn,
Secretary

THE AMERICAN CHEMICAL SOCIETY—VI

ORGANIC DIVISION

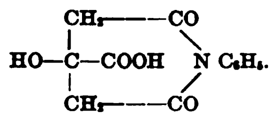
Lauder W. Jones, *Chairman*

H. L. Fisher, *Secretary*

Cymene as a solvent: A. S. Wheeler.

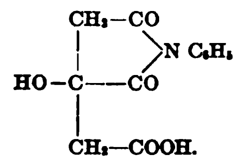
The action of basic reagents on certain Schiff's bases: A. S. Wheeler and S. C. Smith.

Structural problems of the aniline derivatives of citric acid: J. R. Bailey and E. B. Brown. Bailey and Brown show that aniline reacts with methylene citric anhydride giving a product, which readily hydrolyzes with the elimination of formaldehyde and which the method of formation and analysis show to be citranilic acid constituted as follows:



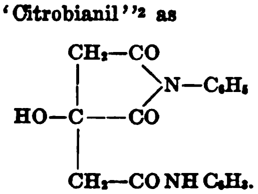
I.

This citranilic acid is a different product from a citranilic acid reported by Pebal,[1] which results from heating the mono-aniline salt of citric acid. With the constitution established for the Bailey-Brown citranilic acid, there remains only the isomeric structure for the Pebal compound, to wit,



II.

This investigation also establishes the constitution of Pebal's "Citrobianil"[2] as



III.

The anilanilde isomeric with III. can be made from citranilic acid I. The proof of structure of the two aniline derivatives of citric, II., and III., is typical of the theoretical deductions to be made concerning a number of correlated substances, the structures of which prior to the investigation of Bailey and Brown were in doubt. The detailed results of this work, when completed, will be submitted to the *Journal of the American Chemical Society* for publication.

The synthesis of capric acid: G. D. Beal and J. B. Brown.

The action of phosphorus trichloride on ketones and aldehydes: James B. Conant and A. D. Macdonald.

Condensation of acetylene with benzene and its derivatives in the presence of aluminum chloride: Otto W. Cook and Victor J. Chambers. Benzene, in addition to sym. diphenylethane and traces

[1] Ann., 82, 92 (1852).

[2] Ann., 82, 87 (1852).

of styrene[3] produces 9, 10-dimethylanthracene-dihydride. Toluene gives xylene, mesitylene, pseudocumene, ditolylethane, and 2, 7-dimethyl anthracene with some 2, 6-dimethyl and beta monomethyl anthracenes. Chlorbenzene produces p, p-dichlor diphenylethane and at least one higher compound as yet unidentified. Nitro benzene does not condense. The investigation is being continued.

The structure of azoxy compounds: OLIVER KAMM AND E. E. A. CAMPBELL.

The purification and some physical properties of some aliphatic alcohols: R. F. BRUNEL.

The limit of esterification of certain aliphatic alcohols and acids: R. F. BRUNEL AND ELSIE TOBIN.
Schiff bases and related compounds: WILLIAM J. HALE.

The oscillation theory of colors—hydrazobenzene and azobenzene: GERALD L. WENDT, RUTH O'BRIEN AND F. W. SULLIVAN.

The chemistry of the heptane solution: (I.) Introductory remarks; (II.) Physical constants of heptane: EDWARD KREMERS.

The chemistry of the heptane solution: (III.) Purification of heptane; (IV.) Hydrohalogen solutions of heptane: D. C. L. SHERK.

Report on the production of synthetic organic chemicals in the research laboratory of the Eastman Kodak Company for the year 1918–19: C. E. K. MEES.

Perchlormethylmercaptan: OREGON B. HELFRICH AND E. EMMET REID.

Butyl alcohol as medium for saponification: A. M. PARDEE, B. HASCHE AND E. EMMET REID.

Halogen-substituted phenacyl bromides as reagents for the identification of acids: W. L. JUDEFIND AND E. EMMET REID.

Molecular rearrangement in the acylation of certain aminophenols: L. CHAS. RAIFORD. In the preparation of diacylated derivatives of certain ortho-aminophenols, in which the acyl radicals bound to oxygen and to nitrogen, respectively, are different, it has been found, upon examination of the products, that the heaviest of these radicals was always found attached to nitrogen, regardless of the order in which they were introduced, which indicates a rearrangement in one case. The acyl radicals so far employed are acetyl and benzoyl, and the bases tested are 2-aminophenol, 2-amino-4-methyl-6-bromophenol, and 2-amino-4, 6-dibromophenol. Apparently the presence of an acid-forming substituent in the aminophenol does not change the course of the reaction.

[3] Varet and Vienne, *Compt. Rnd.*, 164–1375.

A more nearly rational system of units: ELLIOTT Q. ADAMS.

Certain metallic derivatives of hydroxy-anthraquinones: M. L. CROSSLEY.

Pyrogenic conversion of phenol to napthalene: M. L. CROSSLEY.

Reduction of dihydroxythymoquinone by means of palladium-hydrogen: NELLIE WAKEMAN. Dihydroxythymoquinone, in alcoholic or ethereal solution, reduced by hydrogen in the presence of finely divided palladium, loses its red color, the solution becoming colorless. Upon evaporation of the solvent, in contact with air, the color returns and red crystals of dihydroxythymoquinone result. Evaporated in an atmosphere of hydrogen, flaky white crystals are obtained. These, upon exposure to the air, change to red dihydroxythymoquinone. Reduced in the same way in acetic acid anhydride solution, dihydroxythymoquinone yields a tetra-acetyl derivative which is stable in the air, and separates in colorless prismatic crystals melting at 180°–182°.

Congo red and some similar disazo-dyes: W. R. ORNDORFF AND F. E. CARRUTH.

Synthesis of anthracene from naphthalene: C. W. COLVER AND W. A. NOYES.

Positive iodine in derivatives of acetylene: L. B. HOWELL AND W. A. NOYES.

The attraction between organic substances and water, and the adsorption of organic substances: W. D. HARKINS.

Determination of the viscosity of pyroxylin solutions: E. F. HIGGINS AND E. C. PITMAN. (By title.)

CHARLES L. PARSONS,
Secretary

(To be continued)

SCIENCE

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